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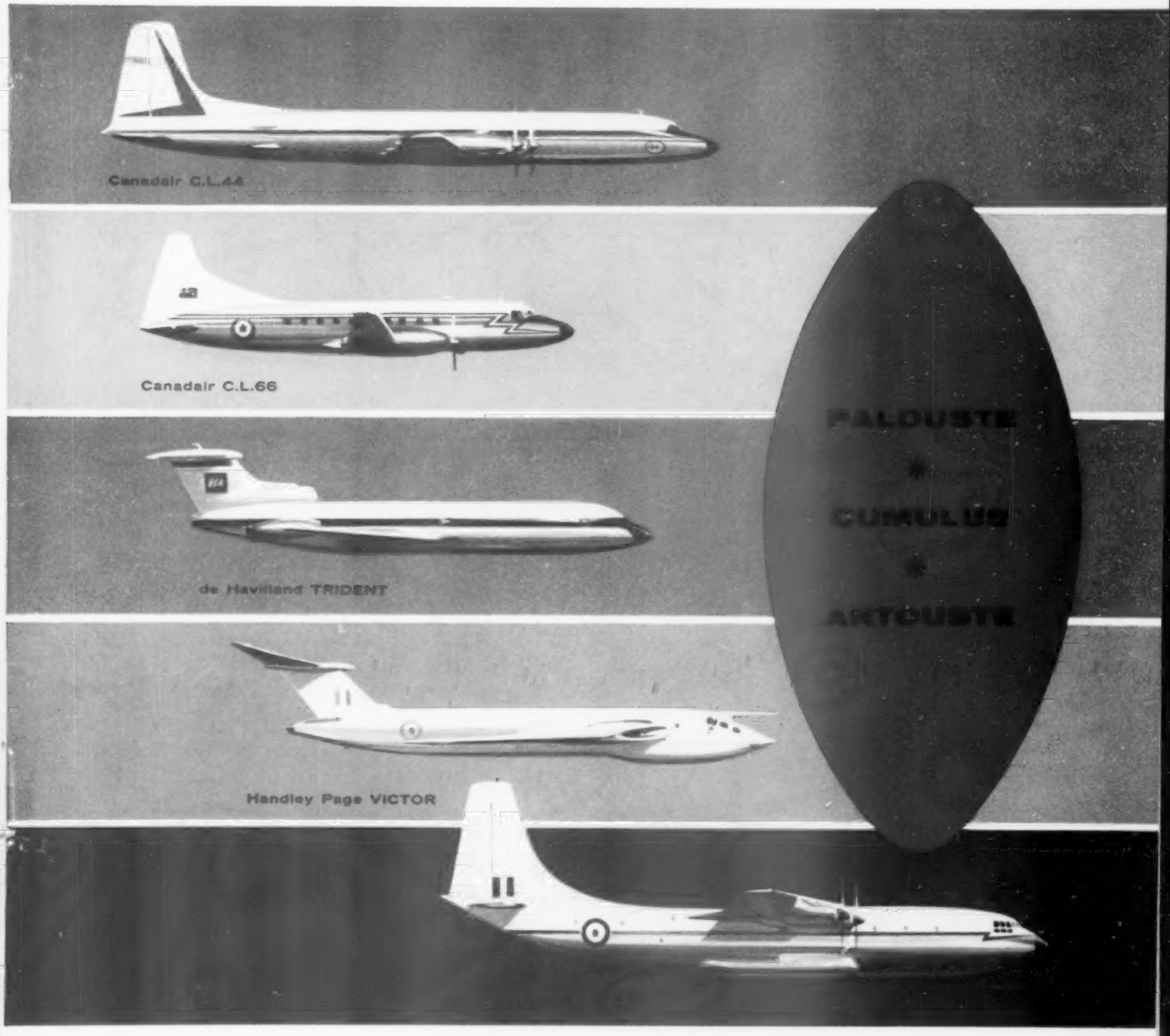

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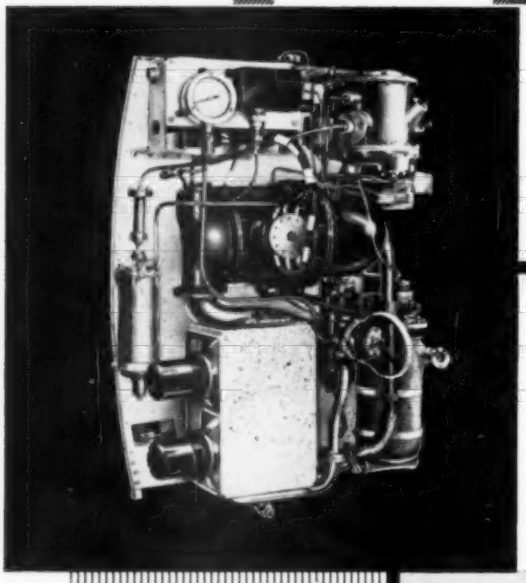

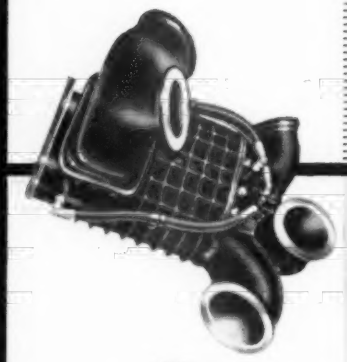

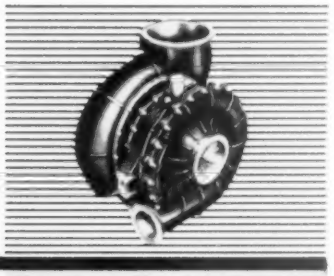

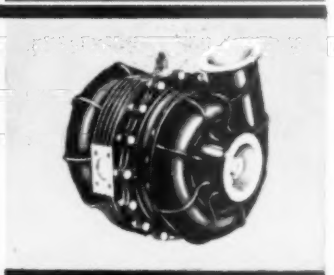

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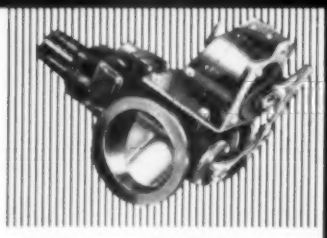

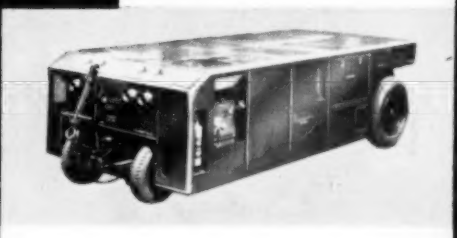

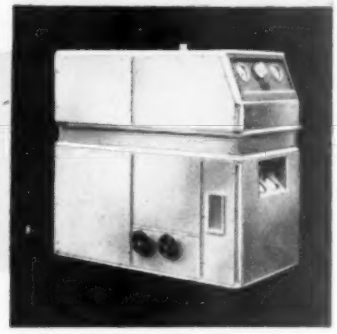

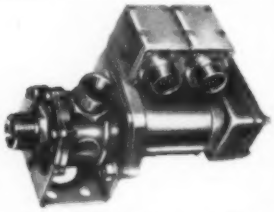

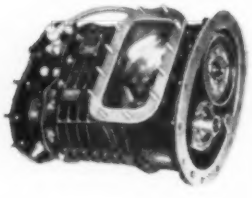

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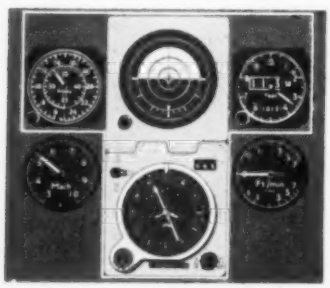
The main pilot's basic instrument display of the flight control systems reflects the layout of the central controller, thereby introducing a natural relationship between the two. The presentation shown here has been designed for the D.H. Trident *and illustrates the clear and positive displays achieved.*



Here is a brief factual report of SMITHS achievements in this field up to the beginning of this year:

SMITHS have been making automatic pilots since 1933.

SMITHS designed and made the first British electrically operated automatic pilot.

SMITHS designed and made the automatic pilot used in the world's first turbo-jet and turbo-prop airliners.

SMITHS automatic pilot (and associated equipment) is the heart of the world's first *fully automatic landing equipment* to go into production. This is the 'Autoland' system, in the design of which SMITHS collaborated closely with the Blind Landing Experimental Unit of the Royal Aircraft Establishment. The 'Autoland' system has been adopted by the Royal Air Force.

SMITHS automatic landing equipment has, in the last ten years, carried out more successful automatic landings than *all* other known systems in the world added together.

SMITHS embarked five years ago on a new generation of automatic pilots, designed to increase the safety factor to a level that will meet the stringent safety requirements that the civil air lines need for automatic landing.

SMITHS latest-generation automatic pilots will be the heart of the automatic system to be fitted in the de Havilland 'Trident' (under construction for BEA) and the Short 'Belfast' heavy freighter (on order for RAF Transport Command). Negotiations are in progress with other operators.

SMITHS automatic landing equipment has been ordered by the USA Federal Aviation Agency for evaluation tests in America.

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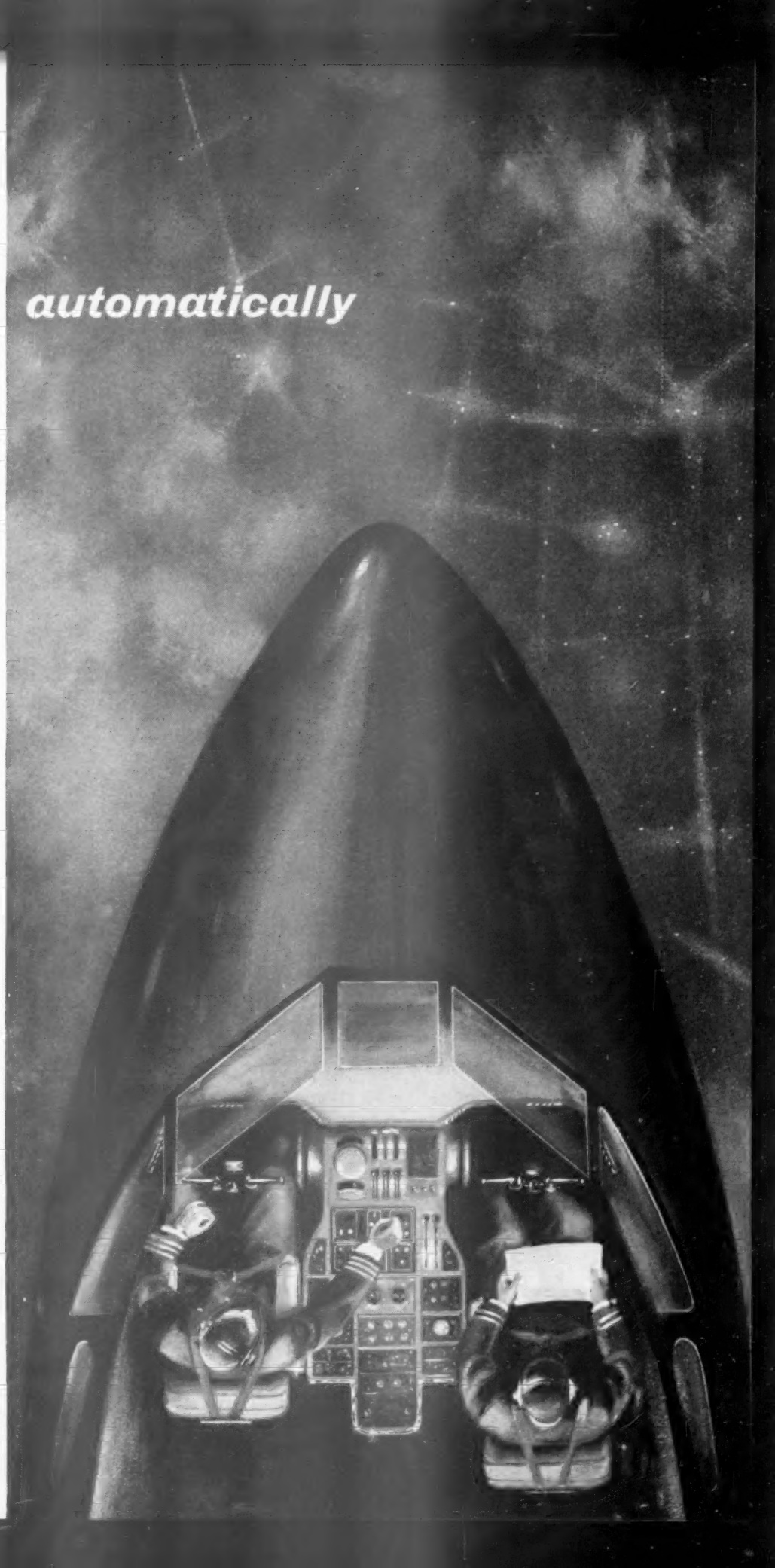

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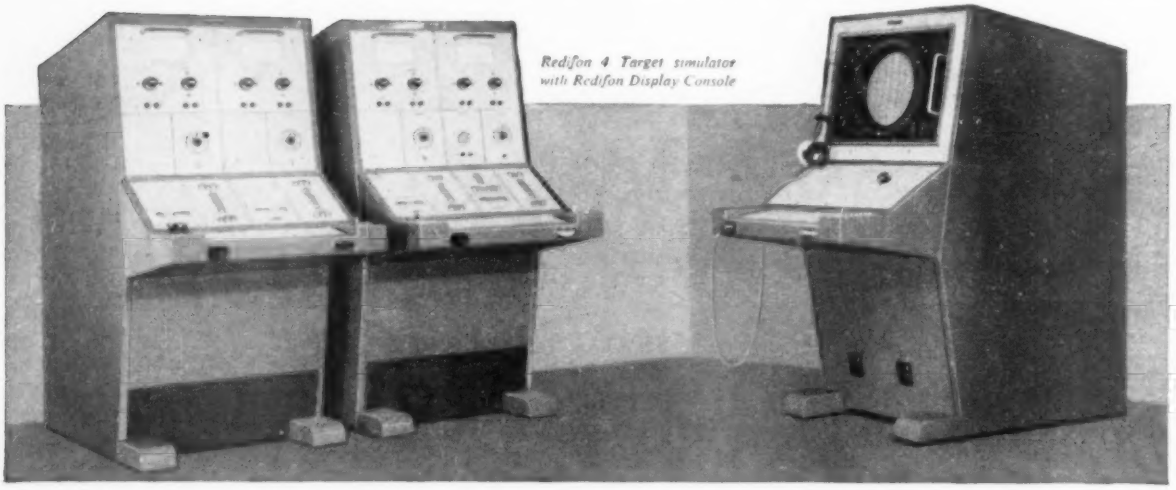
for training air traffic control and other ground to air radar officers



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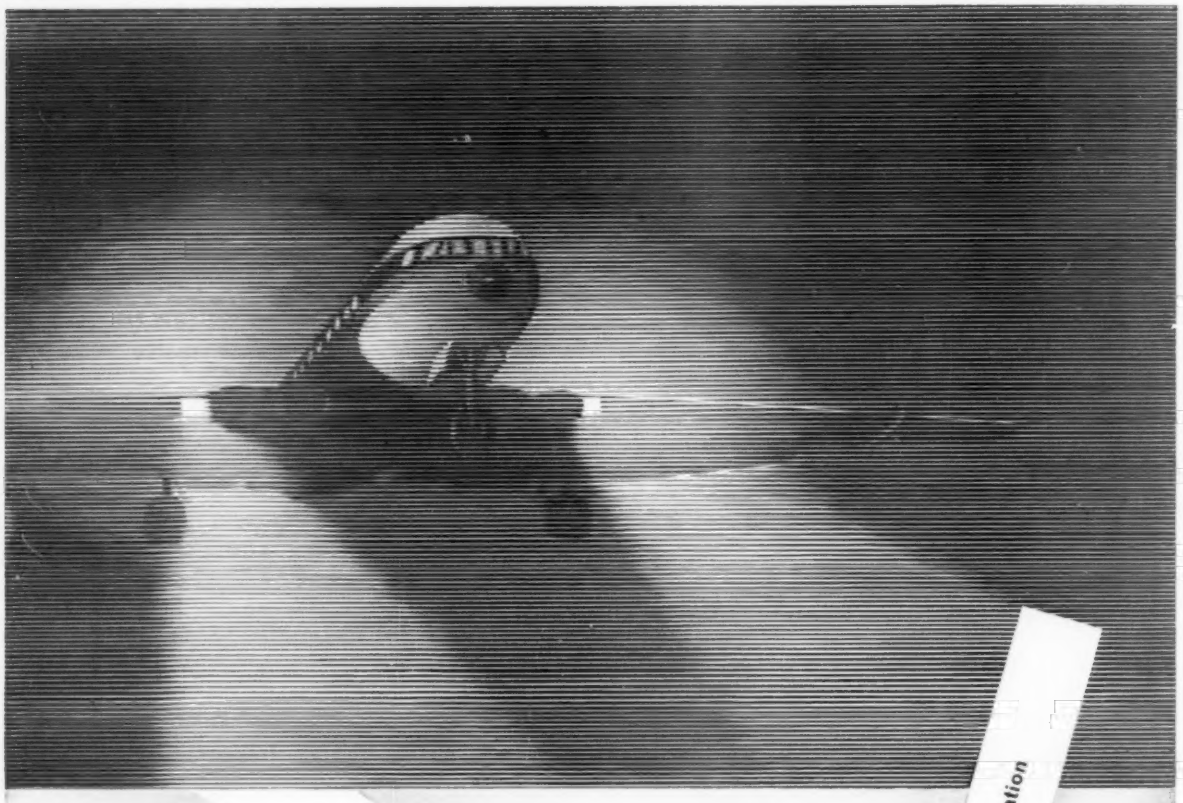

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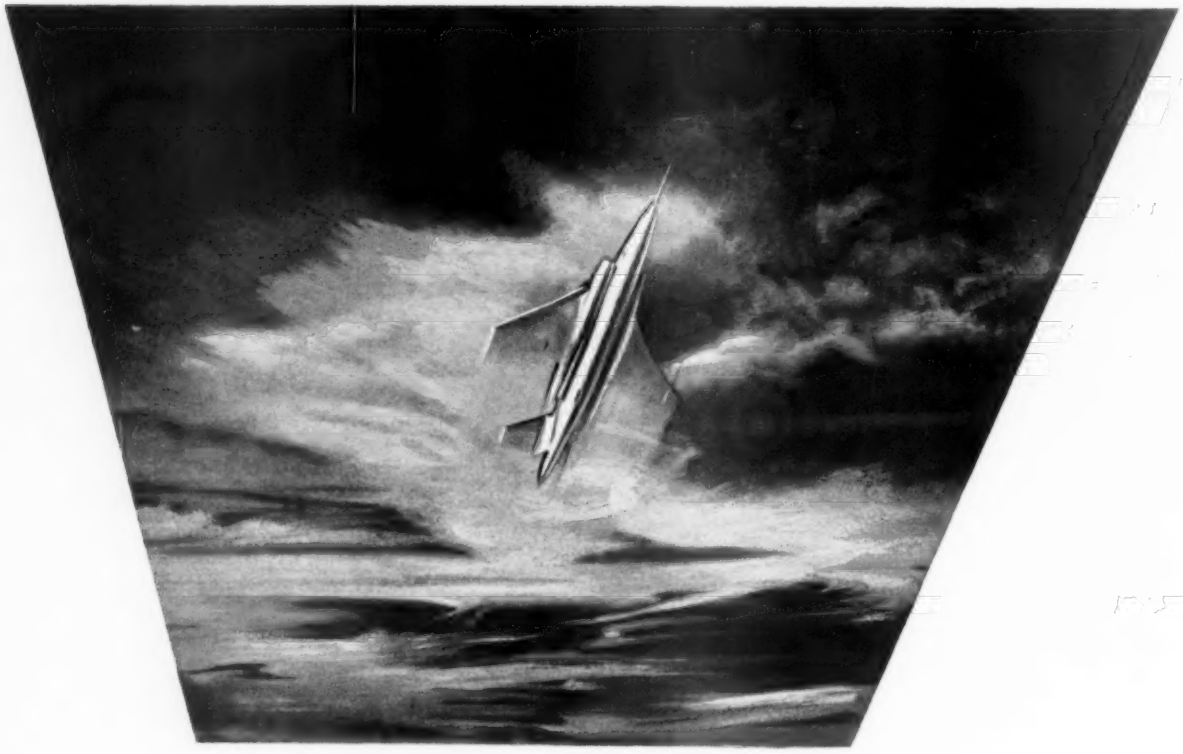

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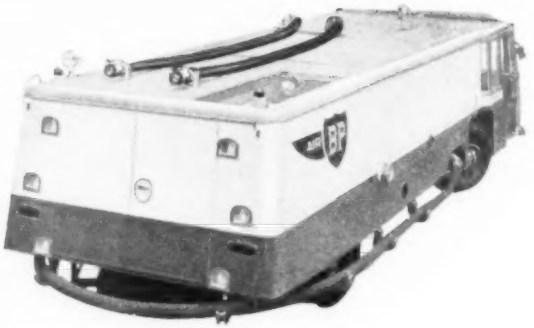

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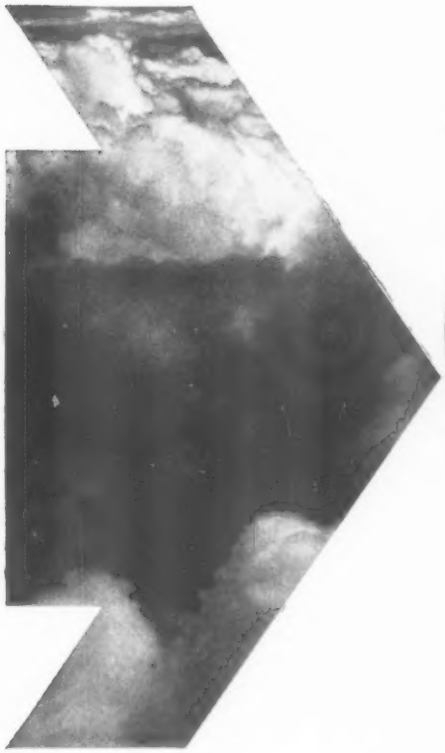

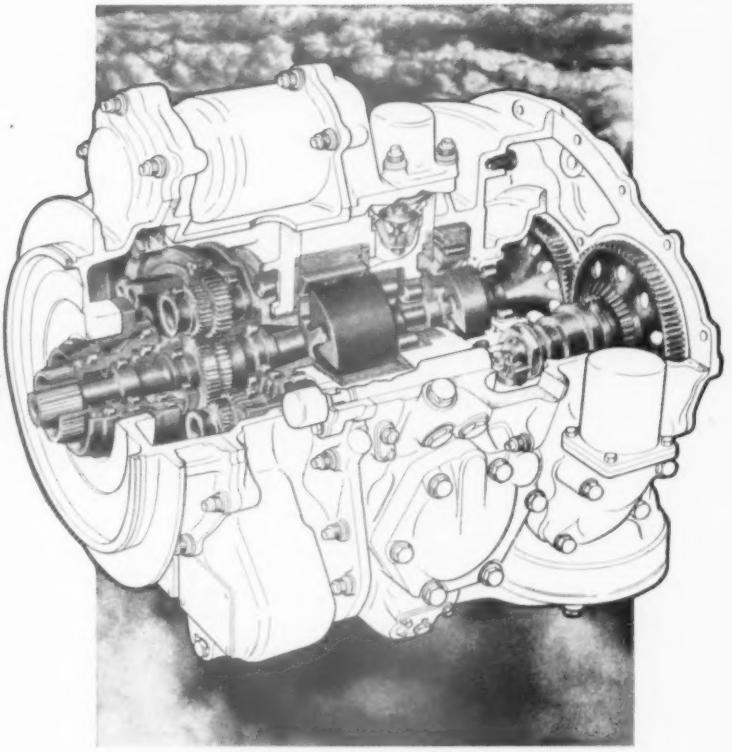

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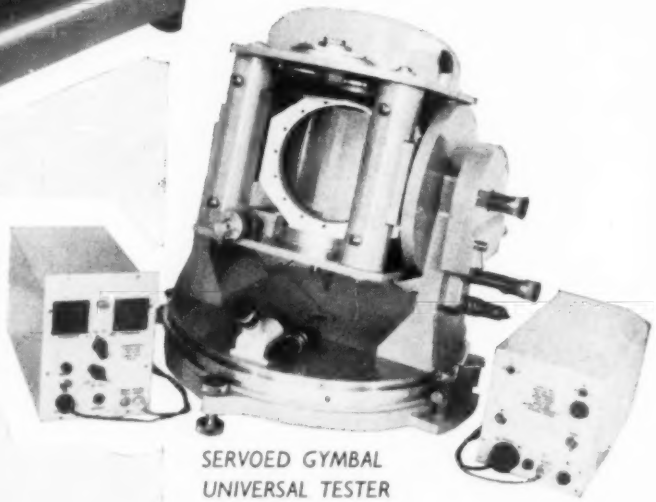

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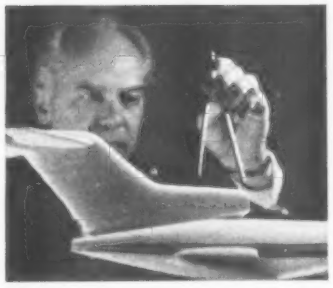
Fifth engine tests Boeing 727 design feature



The Boeing 707 prototype, which proved out advanced design features of the Boeing 707 and 720 jetliners, is now at work as a flying test bed for the next generation of Boeing jets—the three-engine short-range 727.

The prototype is shown above equipped with a fifth engine, conducting exhaustive tests of the efficiency and performance of side-mounted engines, a feature of the 727. In addition, the 707 prototype is testing new high-lift wing flaps, aircraft systems and other design features that will make the 727 the most advanced jetliner of its class.

Already, ninety-two 727s have been ordered by Eastern Air Lines, Lufthansa German Airlines and United Air Lines for delivery beginning in 1963. The 727 will operate from 5,000-foot runways with full payload and will serve routes from 150 to 1700 miles. It offers airlines many unique advantages, including components and systems that have demonstrated outstanding performance and reliability in more than 300,000,000 miles of Boeing jetliner operations.

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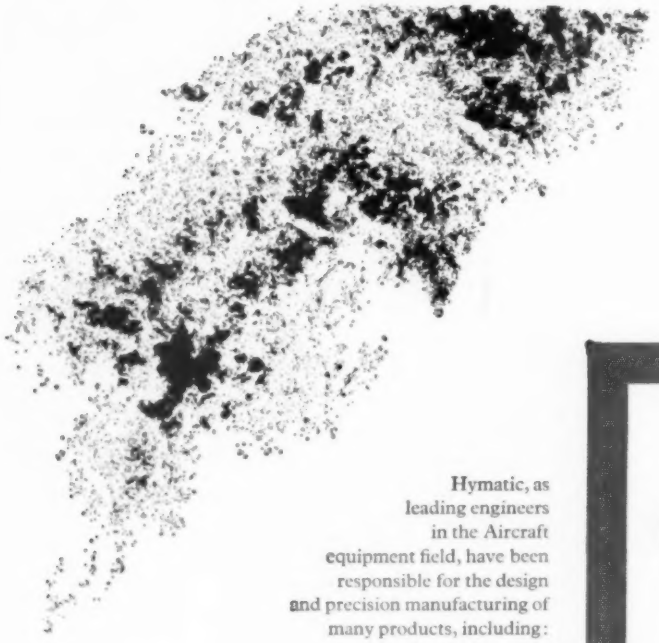

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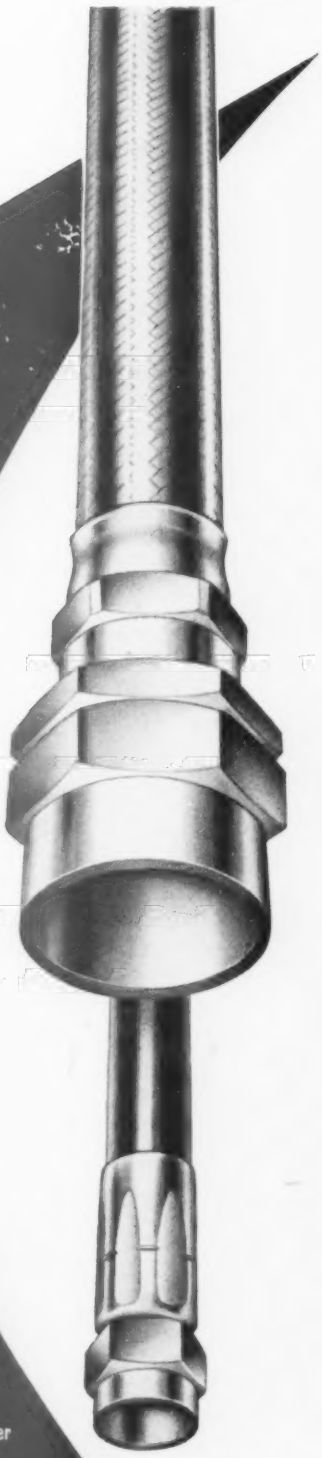

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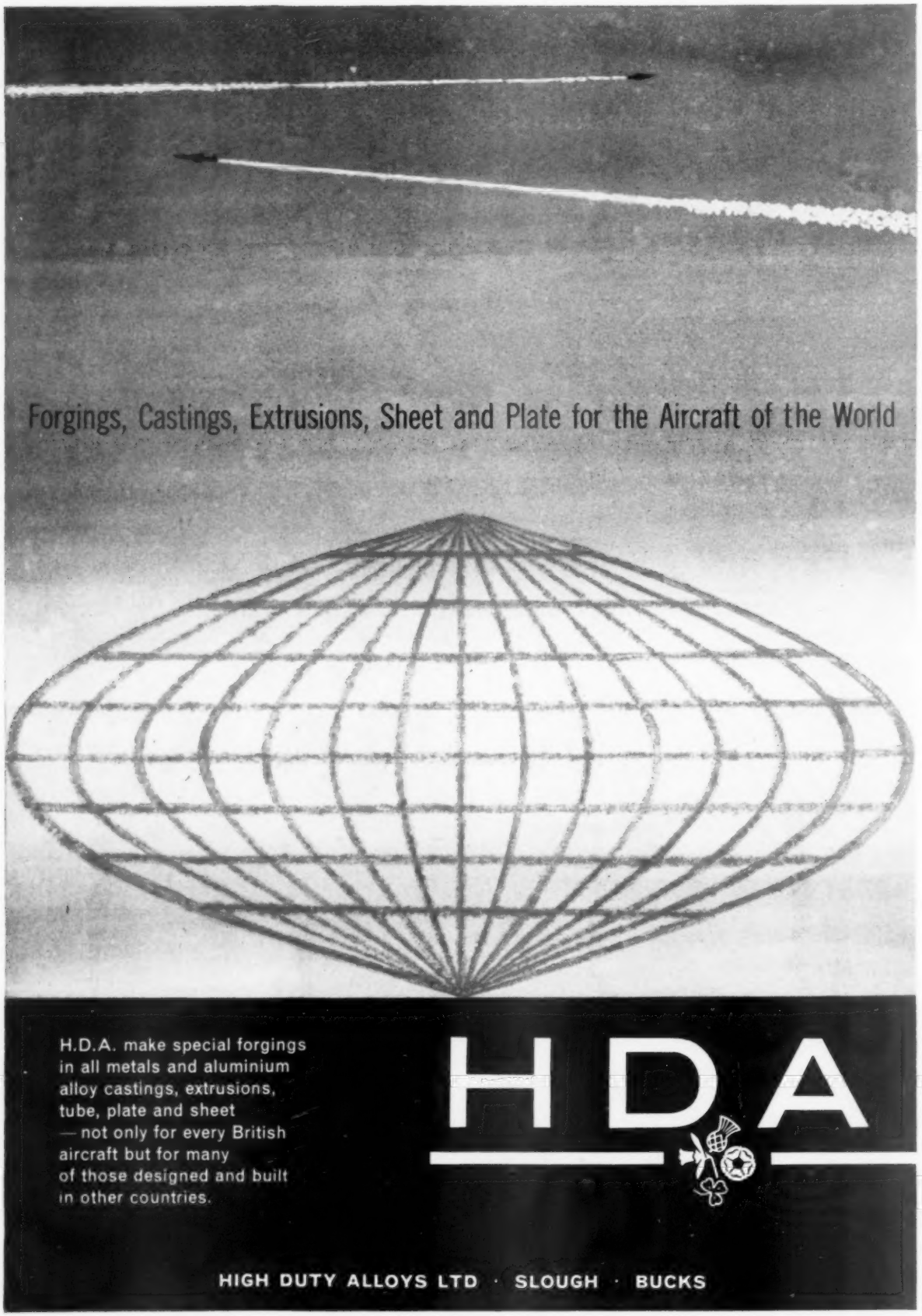
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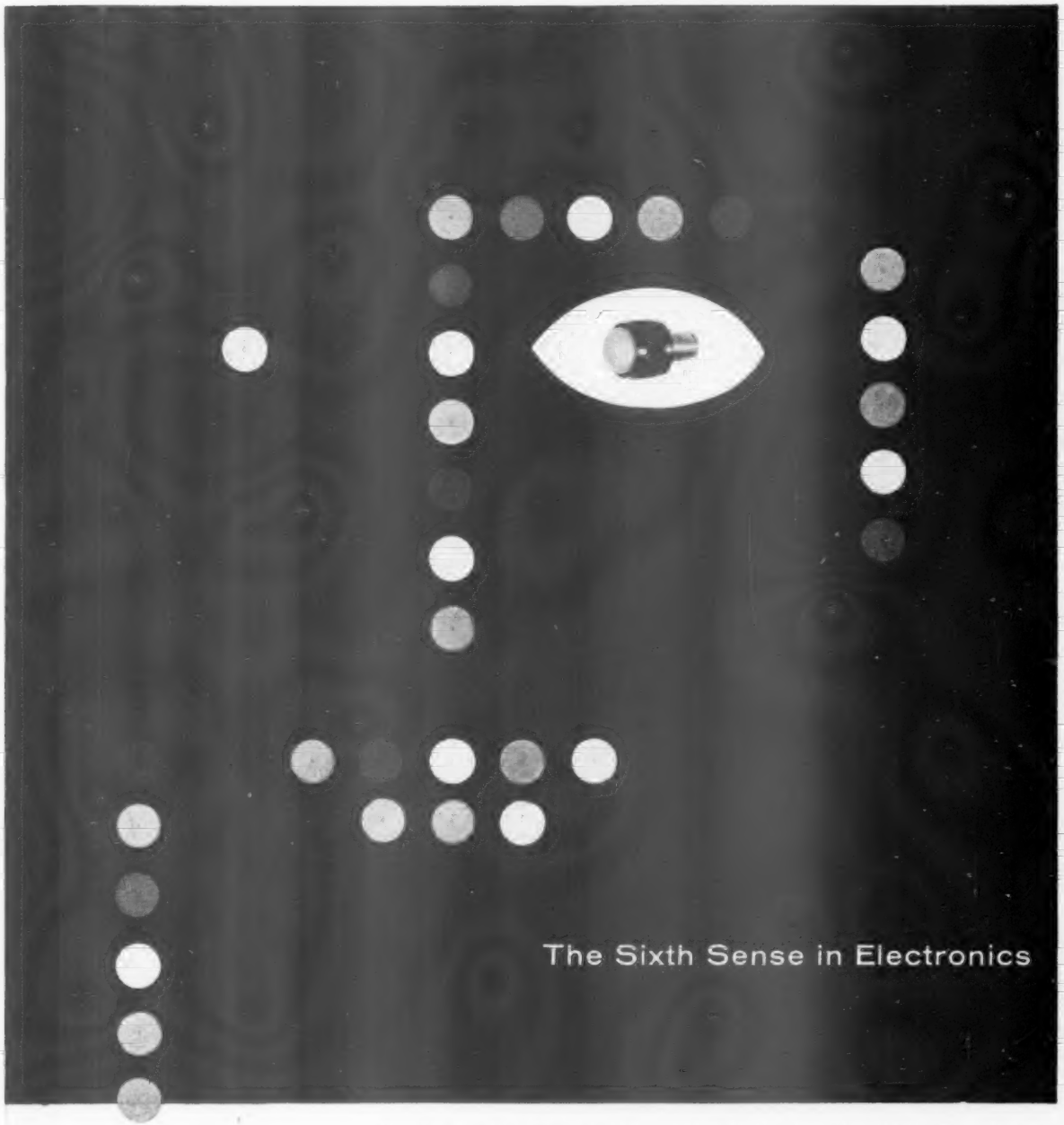

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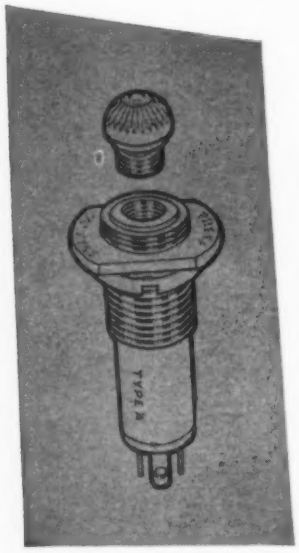

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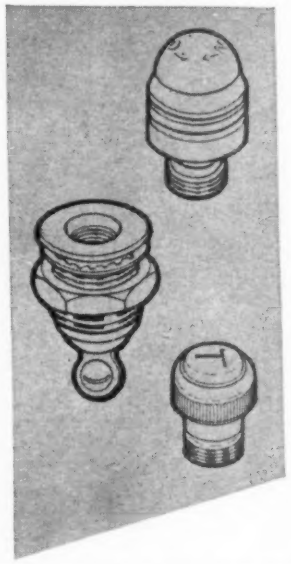

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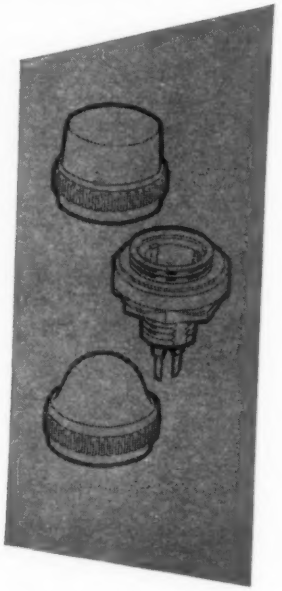

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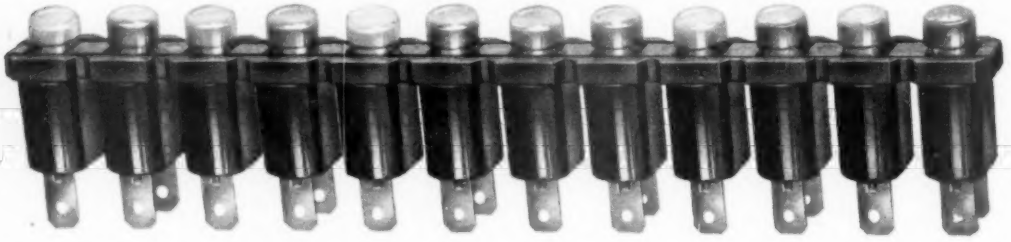

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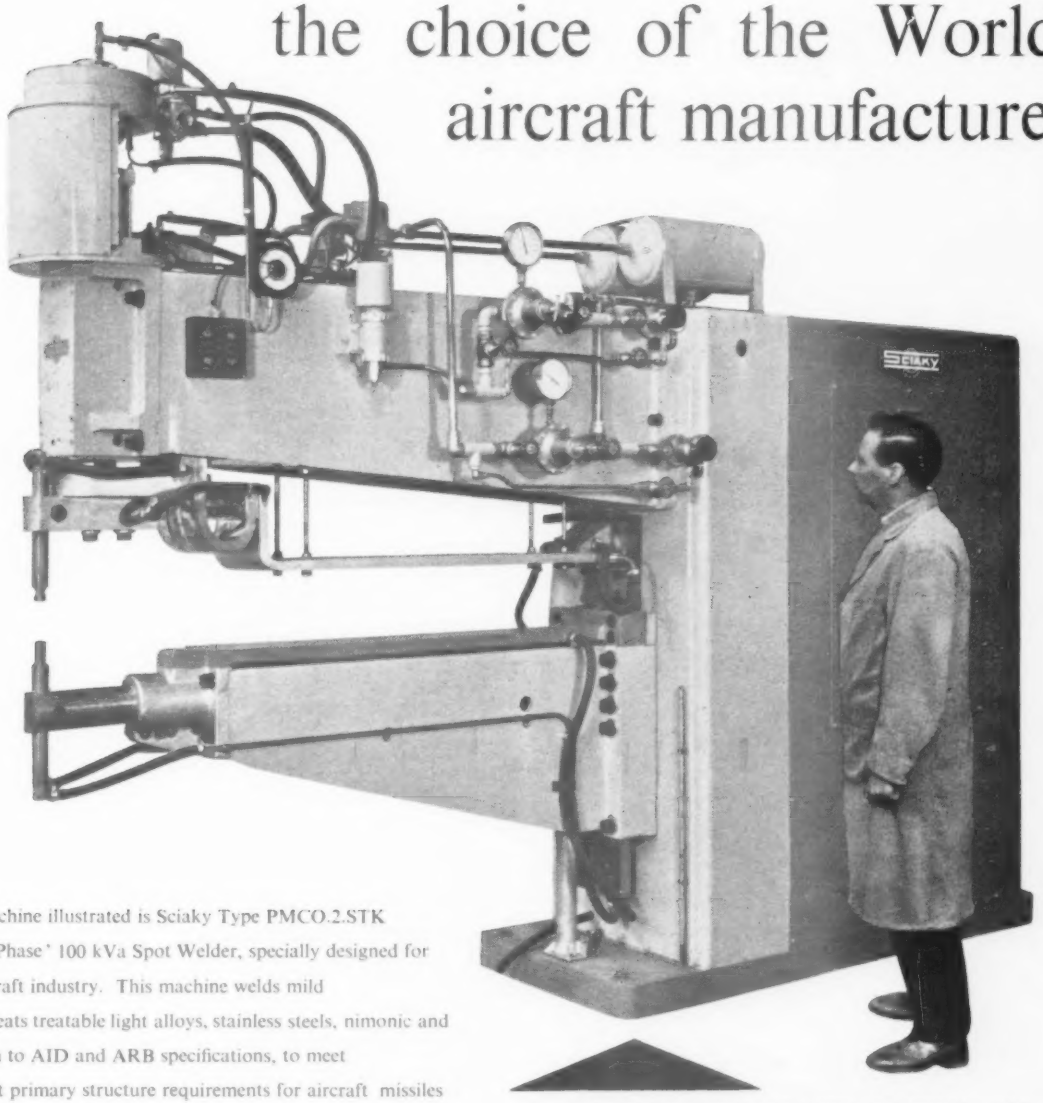

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THE AEROPLANE and ASTRONAUTICS

VOLUME 101 NUMBER 2603 SEPTEMBER 7, 1961

Training for Airline Engineers

When we wrote earlier in the year about the need to attract university-trained engineers to the maintenance and engineering side of the air transport industry, it immediately became clear that the subject was one of wide interest. Among the results was a lengthy written discussion on the subject prepared by Mr. Peter Murray, general secretary of the Society of Licensed Aircraft Engineers. This discussion has since been put in a form suitable for publication, and we count ourselves fortunate in being able to publish such a cogent expression of opinion in this important annual issue. The subject is one of particular importance to the British air transport industry.

Among the proposals raised in our Editorial was that the "sandwich" type of training should be utilized. As we saw it, young men qualifying as craftsmen through appropriate terms of service in the shops should sandwich their practical work with courses in university. This scheme is, of course, widely adopted in engineering generally.

Mr. Murray does not favour this as a solution. Indeed, in his article he says that one university did set out to provide a sandwich scheme which aimed to give top-quality students an apprenticeship, a degree and professional qualification in five years. Mr. Murray recounts that the view of this university was, after examining the problem in detail, that the necessary curriculum could not be achieved within five years.

A proposal likely to arouse more discussion is the contention in the article under review that a "dip. tech." in airline engineering should be instituted. No doubt this proposal will be brought to the attention of the proper authorities of the Ministry of Education.

Meantime, it is already clear that the airlines will be wise to pay far-sighted attention to the problems of recruiting engineering personnel. It would seem that the prizes ought to be extremely attractive in a profession which requires so long and intensive an apprenticeship.

Widening the Scope

No visitors are likely to have been more welcome at Farnborough than the delegates to the 1961 Anglo-American Aeronautical Conference. Organized jointly by our own Royal Aeronautical Society and America's Institute of the Aerospace Sciences, these Conferences have become major biennial gatherings of specialist engineers from both sides of the Atlantic; and they represent an important forum at which much of the latest development in the technological aspects of aviation is widely discussed. This year's event is the eighth in the series and to it delegates have come from Belgium, France, India, Israel, the Netherlands, Norway, Poland, Sweden and Switzerland, as well as from the organizing countries. It is good to find, too, that the Canadian Aeronautical Institute takes part in the organization.

However, during the past few years, the development of trans-Atlantic links in such specialized fields as aeronautical engineering has reached a point that it can almost be regarded as parochial activity. Perhaps the time has come to widen the scope of this particular biennial Conference and bring into its organizing body the professional and technological aeronautical institutions of other countries in the Western European Alliance. In this context organizations such as A.F.I.T.A. in France, the Wissenschaftliche Gesellschaft für Luftfahrt in Germany and the Aeronautical Research Institute in Sweden, come to mind. The broader representation and application thus achieved would be greatly beneficial to aviation as a whole. It would also be a powerful stimulus to real co-operative progress towards what must one day come to be the United States of Europe.

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Matters of Moment

More Export Successes

IT is always good to be able to record continued success in the export of products from Britain's aviation industry. It is all the more satisfactory to be able to do so at "Farnborough time." And the latest figures published by the Society of British Aircraft Constructors on the eve of their annual Exhibition follow the upward trend.

During the first seven months of this year, for example, the total value of the industry's exports was some £95 million—about £8 million more than the corresponding period last year. Of this commendable total, dollar sales accounted for no less than £39 million. Once again, aero-engines and associated parts were responsible for a healthy proportion of the overall effort—more than £50 million worth of goods in this category being sold abroad. This, itself is £6 million more than the corresponding aero-engine figure for the first seven months of 1960.

The £95,016,650 total comprised £25,503,113 for aircraft; £14,448,696 for aircraft parts; £21,125,142 for 568 new engines; £14,036,049 for 888 "other than new" engines; £15,602,078 for aero-engine parts; £2,129,220 for electrical appliances; £561,148 for tyres; and £1,611,204 for instruments.

During the period under review, Canada topped the list of customers for aircraft and parts with £13,400,944 worth of goods bought. The United States came next at £4,621,402, to be followed by the Lebanon (£4,022,990), Egypt (£3,884,711), India (£2,078,008) and France (£1,182,373). In the aero-engine market, Canada again headed the list at £11,245,726. The U.S.A. spent £9,886,789, France £5,175,512, Italy £3,589,459, West Germany £3,241,274 and India £2,917,005.

The recorded January-July total represents an annual aviation export income of £163 million. This compares with the 1959 record total of £156 million. It brings the total post-war aviation export figure to more than £1,179 million.

Bloodhound Developments

FOLLOWING recent news of orders from Sweden and Switzerland for the latest version of the Bristol/Ferranti Bloodhound surface-to-air weapons system, the new low-level capability of this potent missile has now been publicly demonstrated with the aid of some brief shots from a film taken at the Aberporth rocket range at Cardigan Bay. These cine pictures showed the interception of a "fast jet aircraft"—it appeared to be a Meteor target drone—by a Bloodhound 2 at an altitude said to be well under 1,000 feet.

At the time of the announcement of Sweden's Bloodhound 2 order—which, incidentally, was the first from overseas for this particular anti-aircraft weapons system—it was disclosed that the second-generation Bloodhound offered "striking advantages" in virtually every aspect of performance compared with its predecessor. It was said to have greater range, greater lethality and greater operational flexibility. These most worthwhile improvements, it was revealed, were largely the result of using a continuous-wave radar guidance system instead of the pulse-wave equipment used for Bloodhound 1. This C.W. guidance has been developed by Associated Electrical Industries and Ferranti, in conjunction with the Ministry of Aviation.

The release of the film shots from Aberporth is the first indication that development trials with Bloodhound 2 are well under way, if not virtually completed. The next step will presumably be Service acceptance trials and one would expect the weapons system to be in full production by this time next year.

A New "Missile Gap"?

THE decision of the Soviet Union to resume the testing of nuclear weapons, and the announcement that Russia has worked out projects for creating a series of "super-powerful" nuclear bombs with energy yields equivalent to 20, 30, 50 and 100 million tons of TNT, raises many questions.

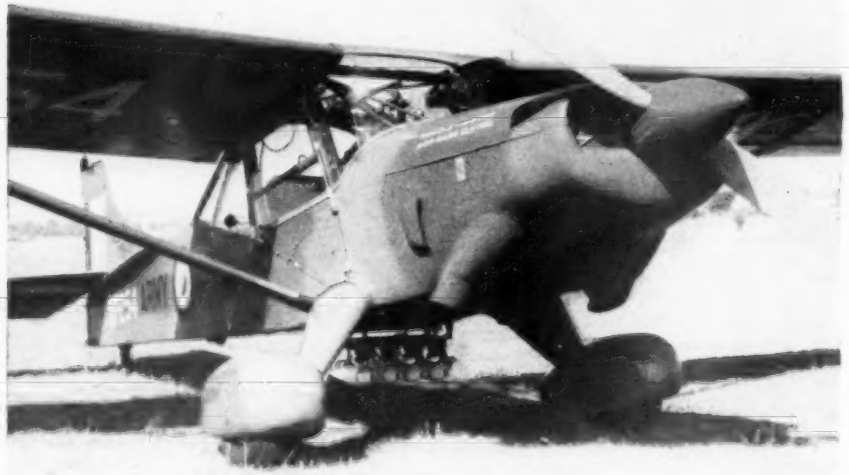
First is the possibility of Russia testing nuclear weapons in space. One of the most effective methods of eliminating unwelcome satellites orbiting over Soviet territory, for example, would be to saturate them with heat and radiation from an atomic explosion. To perfect this technique, it would be necessary to conduct tests with anti-satellite missiles—and, of course, target satellites.

The fact that the Russian statement has coupled the 20-100 megaton bombs with rockets similar to those used in the Gagarin and Titov orbital missions presents something of a challenge to the West. The trend of thinking on nuclear weapon delivery in the United States has led to the concept of comparatively small ICBMs capable of maximum concealment or mobility, such as the land-based Minuteman and the sea-based Polaris. These are believed to have energy yields of about two megatons and 0.5 megatons respectively.

For comparison, Atlas D and Titan I are believed to have warheads in the 3 and 4 megaton range. Higher-yield lightweight warheads are, however, in the making.

The idea of developing anything so powerful as a 100-megaton bomb has been largely dismissed in the United States, although it is conceded to be within the bounds of accomplishment. As Senator Clinton Anderson, a member of the Joint Congressional Committee on Atomic Energy, put it on Aug. 31, "The 100-million-ton equivalent bomb is not impossible. Some time ago the United States started to develop a very large one but there was not a target to use it on."

If Russia is to build such devastating weapons, and use their most powerful multi-stage space-boosters to carry them, must the West follow suit? If Russia is really in earnest, the challenge



FOR OBSERVATION.—This close-up of the Beagle-Auster A.O.P. Mk. II shows the Agricola-type installation of its 260-b.h.p. Rolls-Royce Continental IO-470, its spats and strut fairings, and underfuselage flare rack.

Photograph copyright "The Aeroplane and Astronautics"

NEW ROTORCRAFT.—These three views of the little Beagle-Wallis WA 116 autogyro show its simple tubular airframe and general configuration, although they give little idea of the vigour with which it was flown by Wg. Cdr. Wallis. One view shows him demonstrating the feet-and-hands-off stability of this little gyroplane, which seems to have many applications for both civil and military rôles where low cost and STOL performance are important considerations. Wg. Cdr. Wallis expects to be able to loop and barrel-roll the WA 116.

Photographs copyright "The Aeroplane and Astronautics"

cannot be ignored. Exactly how massive nuclear bombs in this class are likely to be is not known, but it is evident that extremely large rockets will be needed to carry them. The lifting power of the Vostok launcher has already been demonstrated—10,500 lb. into close-orbit—and it may have much greater capabilities with further development, e.g. with different upper staging.

To enter this competition, the United States would be faced with developing ballistic missiles in and probably beyond the Saturn class. Saturn, however, is still some three years from becoming operational as a space-booster and has yet to see its first launching with dummy top stages.

Thus, the present situation is likely to demand some urgent rethinking within the Pentagon. It could represent a rather formidable new "missile gap."—K.W.G.

Beagle's Farnborough Preview

SHOREHAM, last Thursday, in brilliant sunshine was an S.B.A.C. Show in miniature for the Beagle Group, which showed the full range of aircraft and mock-ups being currently presented at Farnborough, plus an additional exhibit excluded by its non-British engine. The McCulloch-powered Beagle-Wallis WA 116 autogyro was flown with a brilliance by Wg. Cdr. Ken Wallis which might well have made it, together with the B.206 executive twin, the joint star of this year's S.B.A.C. Show.

As it is, John Nicholson's upward rolls in the seven-seat Beagle-Mansfield B.206, which has been flying for little more than a week or so, will probably be the main source of comment in the Farnborough flying programme. Resplendent in its Beagle-bronze and white colour scheme, the B.206 emerged from the Shoreham paint shop at the beginning of last week, and continued its flight test programme with the same giant strides as it started. Its single-engine performance is being confidently demonstrated, together with other extremes of handling.

The flight demonstration of the Wallis gyroplane, which represents a number of significant advances on the original Bensen formula, is equally startling. Close examination of the little WA 116 was not possible because of a number of features on which patents are pending, but its development has clearly reached an advanced stage. After an engine-assisted rotor spin-up in the centre of the airfield, the WA 116 took off in a very light wind in a few yards, and climbed at such a rate and angle that it appeared to have reached about 1,000 ft. over the boundary.

Wg. Cdr. Wallis cruised overhead with hands and feet off the controls, to show the above-average stability of the WA 116, and did a touch-and-go landing directly across the light wind, arriving at no more than a brisk walking pace. He swept in and out of the parked aircraft a few inches above the ground and after soaring up again in a blast of two-stroke fury, switched off the McCulloch flat-four completely and autorotated down for a dead-stick landing. The ground run seemed to be no more than about 15 yd.

Also shown was the third pre-production Airedale, G-ARNP, with the Lycoming O-360 engine, and a slightly modified instrument layout incorporating miniaturized engine gauges. This is also the first Airedale to have nosewheel steering disconnect in flight, which will be a feature of the definitive aircraft. G-ARNP is being shown statically at Farnborough, where its high quality of furnishing will undoubtedly be of interest, while flight demonstrations are being performed by the prototype Airedale, G-ARKE, re-engined with the 175-b.h.p. Rolls-Royce/Continental O-300-A.

Another re-engined Beagle-Auster, the Mk. 11, for the Army Air Corps, is being shown, and demonstrated the power margin conferred by its 260-b.h.p. R-R/Continental IO-470 engine at Shoreham last week in the capable hands of Ranald Porteous. Apart from its Agricola-type powerplant installation, and the addition of spats and strut fairings, plus the Army's standard under-fuselage flare rack, the Mark Eleven is otherwise similar to the earlier Mk. 9.

The now-familiar Terrier is again being shown, the current example G-ARRN being fitted with geared tabs to lighten the ailerons, and numerous cockpit refinements. Mock-ups on view included the furnished cabin of the B.206, with five seats plus toilet compartment, and the first showing of the commodious M.218 light-twin cabin. The central instrument layout and left-hand radio panel of the M.218 seem certain to arouse controversy at Farnborough.

DETERRENT TEAM.—First pictures of an Avro Blue Steel stand-off bomb mounted under the fuselage of a Victor B.2 V-bomber.

Back to Malvern

HAVING spent most of his working life at the Royal Radar Establishment, Malvern, and at its predecessor, the Telecommunications Research Establishment, Dr. G. G. Macfarlane is to return there early next year as its new director.

He first went to Malvern in 1939 to work on mathematical problems associated with radar and microwave physics. He graduated from Glasgow University and Dresden Technical High School; at the latter he read subjects concerned with research into theoretical problems in electrical engineering. For 21 years he was closely concerned with R.R.E. departments working either in mathematics or physics. In 1960, however, he was loaned to the Department of Scientific and Industrial Research and became deputy director of the N.P.L.

Herald with a Difference

FOR some time it has been common knowledge that the Handley Page team have been working on a military version of the Dart Herald. No details of this project have, as yet, been made available, but some preliminary information has come from Cricklewood.

The aircraft, described as a "close support military transport" is said to make use of about 80% of the jigs and tools employed in the construction of the civil Series 200 Herald. One of the main structural changes has been the raising of the tail unit and rear fuselage to accommodate under-side rear loading doors. Some local structural strengthening has been made necessary by the military load requirements and, of course, the cabin floor has been reinforced to accommodate bulky concentrated loads.

In its civil form the Herald is already noteworthy for its excellent short-field performance. This new Service version is likely to be even better in this respect, for it will have the more powerful Rolls-Royce RDa.10 turboprops, giving 3,030 e.h.p. for take-off, compared with 2,105 e.h.p. of the present RDa.7. This, says the company, will enable the aircraft to operate at 46,000 lb. from short temporary airstrips.

Particular emphasis is placed on the aircraft's potential versatility in Service use. Seats and equipment are designed for rapid conversion between its many possible rôles—paratrooping, supply dropping, air ambulance, transport, freight carrying, and close air support.

No indication is given as to when the prototype of this military Herald is likely to make its appearance. Presumably, it could be built fairly quickly, because much of the flight test and structural proving done on the civil version will be applicable to the new airframe. Indeed, Handley Page claim the possibility of "remarkable savings" both in the initial cost and in the time within which the aircraft could be in service.

Record "Firsts"

WHEN the Napier Gazelle-powered Westland Bristol Belvedere was taken to Paris for the Salon de l'Aéronautique earlier this year, the opportunity was taken to try to establish a new London-Paris speed record for the Class E Rotorcraft category. Both the outward and inward journeys between the Westland Heliport at Battersea and the Paris Heliport as Issy les Molineaux were officially timed. The resultant times and speeds have now been officially recognized by the Fédération Aéronautique Internationale and constitute the first records set up in this particular class.

The London-Paris Class E helicopter record now stands at 1 hr. 41 min. 23 sec., representing a speed of 125.78 m.p.h. (202.42 km./hr.). For Paris-London the figures are 1 hr. 40 min. 55 sec. at a speed of 126.46 m.p.h. (203.523 km./hr.).

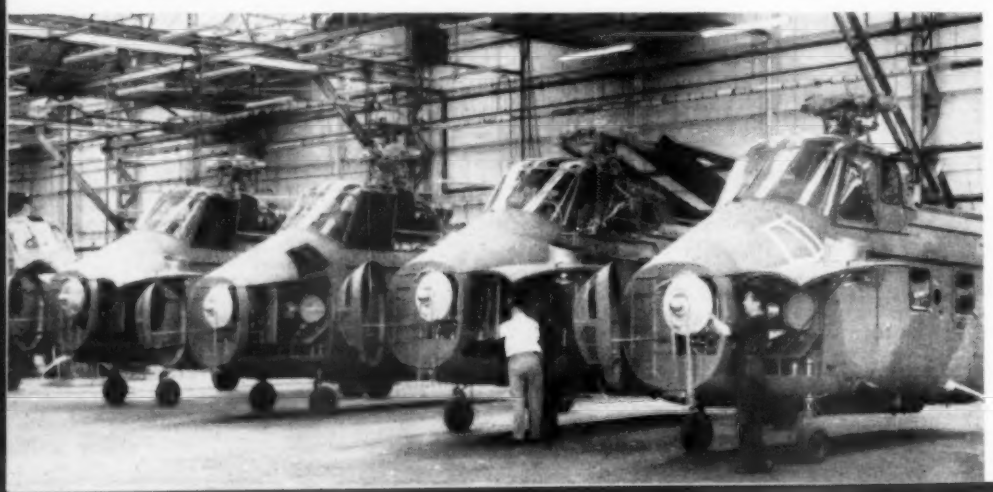
On these flights the Belvedere was flown by Mr. C. D. T. Hosegood, chief test pilot of Westland's Bristol Division, with Mr. D. F. Farquharson as second pilot, and Mr. G. Banks as engineer. Also on board was Sqn. Ldr. I. R. Dowling, C.O. of the R.A.F. Belvedere Trials Unit, and C.O.-designate of the Belvedere Squadron that is to be formed.

Connecticut Forum

PRESENT and future problems for the air transport industry will be discussed during a 20-hour symposium at Hartford, Connecticut, during the first three days of November. The main feature of the symposium ("The Issues and Challenges of Air Transportation")—which is being sponsored by the Connecticut General Life Insurance Company—will be five panel sessions.

The 5-8 specialist members of each of these panels will discuss, in turn, the market for air travel; the market for air cargo; the future air transport systems; airports and communities; and the key issues of public policy in aviation. The panelists will include Prof. Paul Cherington, Prof. Stanley Brewer (each of whom has been responsible for important air transport studies), Robert Prescott (Flying Tiger), Gen. E. R. Quesada (former F.A.A. administrator), Jerome F. Lederer (Flight Safety Foundation) and Stuart G. Tipton (A.T.A. president).

There will be talks by Najeeb Halaby (present F.A.A. administrator), Alan S. Boyd (C.A.B.) and Dr. Hans Heyman (Rand Corporation) and the session will open on the evening of Nov. 1 with, by way of general introduction, addresses on the rôle of aviation in the 1960s and on the technology of flight.



REJUVENATED.—The performance of the Whirlwind has been greatly improved by the installation of the D.H. Gnome shaft-turbine. New Whirlwinds for the R.A.F. fitted with this engine are in production at Westland Aircraft's Yeovil factory (seen here) while at Weston-super-Mare existing aircraft are being re-engined.

OPtional Reading—10

THE larger airlines are not usually slow to order new devices if they can see in them a definite step forward in the field of navigational safety and efficiency. In the case of airborne radar they were, except perhaps for U.A.L., a year or two later than they need have been; but, in the case of integrated flight instruments, VOR, Doppler, identification radar, high frequency radio telephone and 50 kc/s separation VHF, the orders went in about as soon as the equipment had been developed to a marketable stage. Some of the orders could have been put off for a few years without visible loss of operational standards, but the airlines looked ahead, sometimes making provision in new aircraft for equipment which was hardly beyond the prototype stage.

Readers of this column will hardly expect me to go on in this eulogistic vein—so I hasten to come to the exception. This is radio-teletype. Why have the larger operators not ordered radio-teletype?

I find this question very hard to answer. But, before attempting to do so, let me say that one airline, B.O.A.C., is entirely beyond criticism here; indeed, B.O.A.C. was very largely responsible for developing the equipment and has, I think, a very just grievance in finding its fellow operators so slow to follow.

The history of radio-teletype goes back a very long way and I do not pretend to know it. But some years ago I was talking to a German Telefunken man and he showed me a specimen of their "Heltype" system as used for news services; it could be used on long and short waves, he said, and should be easily adaptable to ground-to-air transmissions. A little later, I found that B.O.A.C., with the support of the (then) Ministry of Civil Aviation, had actually started a trial Met. broadcast service on the North Atlantic, using a Stratocruiser and experimental ground stations in Canada and Scotland; with the success of these trials, the experiment was extended to the whole of the DC-7C fleet. Again there was success and by 1959 development of the airborne equipment was complete; and by that time the pilots knew that here was a service which could feed to them (in plain language from Scotland and in self-evident code from Canada) weather actuals and forecasts for 15 main terminals on each side of the Atlantic.

It was a service which did not need continuous monitoring, did not demand attention (as does Volmet) at particular times, did not need taking down on paper and, even though the ground stations were operating at only a fraction of design output, gave coverage over the Atlantic—sometimes indeed, when voice communications were "out." Furthermore, it put an end to the need for request/reply weather, a service otherwise frequently invoked when, as was often inevitable, the Volmet was missed; and in so doing it relieved congestion on the overcrowded HF/RT channels.

With all these virtues and no vices (not even those of weight or excessive cost), one would have thought that other airlines would have quickly followed B.O.A.C. But not a bit of it; at successive IATA and ICAO meetings the equipment was discussed but damned with that faint praise: "recommended for further evaluation." Rubbish; by the time of the ICAO COM meeting, the equipment had already been evaluated and had come through with flying colours, even in the face of a half-hearted contribution from the Canadian side.

In view of the usual ready uptake of bright ideas by the airlines, this situation is mysterious and invites speculation. I once held the theory—and have not yet fully discarded it—that, if a company had a bright idea in electronics, it was unlikely to sell it as a World-wide service unless it was first sold to the U.S. military (consider here VORTAC, HF single-side band and UHF). As radio-teletype is easily jammable in war, it is not a system which appeals to the military; discouragement from this quarter percolates down through such channels as the electronics committee of the A.T.A. and so on to the major American airlines; in other countries, too, this military filter may have an influence. Anyhow, the net result is that Canada has been unwilling to provide a fully operational ground station until a number of major Atlantic operators have requested it and, at least up to the recent past, these requests had not been received.

But now comes the hour of redemption. At the ICAO North Atlantic Regional meeting in Paris, this month, the item is again open for discussion. There is nothing, so far as I know, to prevent the meeting from wholeheartedly recommending ground-to-air radio-teletype for the transmission of weather information for North Atlantic terminals, at first supplementing Volmet, but perhaps eventually replacing it. And, on the basis of this recommendation, there is nothing to prevent the ICAO 7th COM meeting, which follows in Montreal next January, from giving it World-wide application. Of course, if something better is *immediately available*, let us have that—though I do not know of anything. But please, do not recommend radio-teletype "for further evaluation."—C.C.J.

Aviation News in General

HEAVIER HERALD.—An increase in the gross weight of the Handley Page Herald, from 40,000 lb. to 43,000 lb., is offered by the makers in conjunction with a new heavy-duty undercarriage. This undercarriage can be fitted retrospectively to existing Heralds, and will be introduced as standard on the 22nd production aircraft *et seq*. For a very small reduction in block-speed, the heavier Herald carries greater payloads over given ranges.

FIRST FOKKER F-104.—A November first flight is scheduled for the first F-104 assembled by Fokker as part of the ARGE Nord group of European manufacturers. The first 30 aircraft in this programme are to be assembled from Lockheed and Canadair assemblies and sub-assemblies.

YS-11 PROGRESS.—Construction of the YS-11 Dart-engined transport prototype by a consortium of Japanese manufacturers is on schedule for roll-out in December and a first flight in mid-February, 1962. The Ministry of International Trade and Industry recently forecast a requirement for 155 YS-11s by 1965, with 110 for domestic trunk carriers and 45 for local service airlines.

KRIEGSMARINE INTEREST.—A Blackburn Buccaneer has recently returned from West Germany after its demonstration to senior officers of the West German Navy. The aircraft, flown by Blackburn chief test pilot Mr. Derek Whitehead, was accompanied by a sales and technical team.

CARVAIR SET-BACK.—The successful progress with the test flying of the prototype ATL-98 Carvair has been held up following a ground accident in which the stationary aircraft was hit by a carelessly driven fork-lift truck which seriously damaged the tail structure. Flight trials are expected to be delayed by about a month.

FASTEST FEMALE.—Miss Jacqueline Cochran has, subject to confirmation, become the fastest woman in the World by averaging 842.6 m.p.h. in a Northrop T-38 Talon on Aug. 24. This was over a 15-km. course and exceeds the previous best over this distance—by Mme. Jacqueline Auriol in a Mystere IVN, in May, 1955—by more than 100 m.p.h.

MONOSPAR ARRIVAL.—The General Aircraft Monospar, which on Aug. 18 set out from Sydney for the flight to England, is scheduled to arrive at Lympne Airport on Oct. 1. The last leg will be from Paris.

STARFIGHTER MOBILITY.—A 2,300-mile non-stop trans-Pacific flight from George A.F.B., Calif., to Hawaii, has been made by four U.S.A.F. F-104C Starfighters. They were twice flight-refuelled.

SCRAMBLE.—The third and fourth CF-104s taking off from Canadair's Montreal airfield. All CF-104s are fitted with arrester hooks and 18-ft. ring slot braking chutes, instead of the 16-ft. type standard on U.S.A.F. aircraft, because of their higher gross weight.

Continued from previous page

LOW-LEVEL SPEED RECORD.—A new World speed record in the limited altitude category (maximum permissible height 320 ft.) is claimed by the U.S. Navy for a McDonnell F4H-1 Phantom II which averaged 902.769 m.p.h. over a 3-km. course at White Sands, New Mexico, on Aug. 28. Current record holder in this class is a prototype Douglas Skyray which in 1953 averaged 752.94 m.p.h.

X-15 TEST.—On Aug. 11 the North American X-15 No. 1 made its first flight after installation of the 57,000-lb. XLR-99 engine; all previous flights with this aircraft had been with the two XLR-11s of only 8,000 lb. thrust each. It was flown on Aug. 11 by Cdr. Forrest S. Petersen, U.S.N., and reached Mach 4.1 (2,720 m.p.h.).

LOCKHEED 300.—This designation is reported to apply to the commercial version of the C-141 turbofan freighter now under development for MATS. Powered by 21,000 lb.s.t. TF33-P-7 engines, it will have a military mechanized loading system.

NEW HERCULES AIRBORNE.—The first Lockheed C-130E made its first flight on Aug. 25 from Atlanta. Sixteen are at present on order for MATS—the first to enter service next March—and further orders are expected within the current fiscal year to bring the total up to 99.

PYE APPROACH AID.—An instrument landing system for Bratislava International Airport has been ordered from Pye Telecommunications by Czechoslovakia. Two Pye installations are already in use at Prague. The latest contract also covers the supply of transistorized radiotelephones for use on Czech airfields.

FORTY-FOUR GROWTH.—A 5,000 lb. increase in the gross weight of the Canadair Forty-Four, to 210,000 lb., is made possible by minor modifications to the structure. The range with full payload (63,900 lb.) is increased by 11% to 3,250 st. miles, and the range with full tanks (37,300 lb. payload) is increased by 15% to 5,660 st. miles.

PAKISTAN F-104s?—It is reported that President Ayub Khan of Pakistan obtained a promise of F-104 Starfighters and surface-to-air missiles during his recent visit to the U.S.A.

ENGINE ENDURANCE.—General Electric's J93 turbojet, six of which, with afterburners, will power the North American B-70 Valkyrie, has been run for nearly 22 hours under Mach 3 conditions. This was part of an endurance test comparable to the preliminary flight-test rating required by U.S.A.F. Temperature and air-pressure conditions at 2,000 m.p.h. were simulated by enclosing the engine in a cylindrical structure similar to a wind-tunnel; high-temperature, high-velocity air is forced to the engine intake by a ram-air compressor.

STOL TYPE. — Two G.E. YT64-4 turboprops have been installed in a D.H.C. 4 Caribou for flight trials. These will be conducted jointly by de Havilland Aircraft of Canada and General Electric under U.S. Navy sponsorship.

JET COMMANDER.—The Aero Commander Model 1121 twin-jet executive, now under construction, will be certificated to CAR 4b standards as a transport aircraft. Certain technical requirements, such as aisle width, which are normally mandatory for a transport category certificate, are being waived by the F.A.A. Performance will be to SR422B standards. Deliveries are offered in the third quarter of 1963, at a firm price of $475,000.

ENGINE APPROVED.—The F.A.A. has certificated the General Electric CT58-110-1 turboshaft for the Boeing Vertol 107-II and Sikorsky S-61 helicopters. The first S-61L will be delivered to Los Angeles Airways later this month.

HUSKIE ORDER.—Additional Kaman H-43B Huskie helicopters have been ordered for the U.S.A.F. under a new $3,560,500 contract. Nearly 50 Air Force bases in the U.S. currently employ this type for crash rescue duties. An H-43B has also recently been delivered to Colombia.

CONTRACTS EXCHANGE. — U.S. military representation at Sikorsky Aircraft has been transferred from the U.S.A.F. to the U.S. Navy, which now has contract administration responsibility for all major American helicopter constructors. In exchange the U.S.A.F. has assumed similar powers with the Martin company.

JETSTAR CERTIFICATED.—A type certificate for the JetStar was formally presented to Lockheed by the F.A.A. on Aug. 29. It places the JetStar in the CAR 4b transport category.

BELL DEBUT.—The Bell YHU-1D Iroquois made its first flight on Aug. 16. With a 1,100 s.h.p. Lycoming T53-L-9 turboshaft, the Iroquois D is an enlarged version of the U.S. Army's standard utility helicopter.

NAVAL TURBOPROPS.—Production of the Allison T56 turboprop will continue to the end of 1963 with the award of a $20,741,000 contract for engines for the U.S. Navy's W2F-1 Hawkeye and P3V-1 Orion. Two other contracts, worth $19,464,000 and $25,153,000 were awarded in 1960.

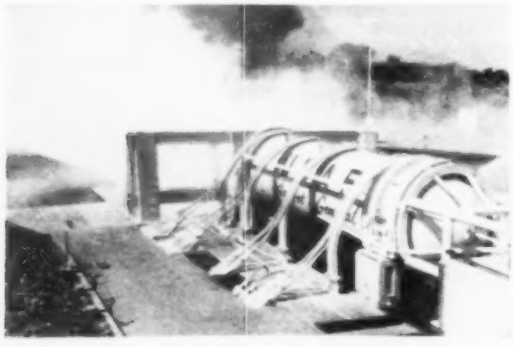
RESEARCH IN ASIA.—The foundations of a wind-tunnel centre which is to form part of the Indian National Aeronautical Research Laboratory, were laid at Bangalore on Jly. 2. Close to the Hindustan Aircraft factory, the centre is to cost an estimated £3¼ million and will take two years to complete.

T53 PROGRESS.—Lycoming's 1,100-s.h.p. T53-L-9 helicopter engine has successfully completed the official U.S. military qualification test. It is to power versions of the Bell HU-1B and also the HU-1D. A turboprop version is now under development for use in the AO-1 Mohawk.

LOCKHEED IN AUSTRALIA.—The Lockheed Aircraft Corporation has formed an Australian subsidy called Lockheed Aircraft (Australia) Pty., Ltd., with offices in Canberra.

A.B.A.C. DINNER. — The annual dinner of the Association of British Aero Clubs and Centres is to be held at the Waldorf Hotel, London, W.C.2, on Nov. 3 at 19.00 hrs. for 19.30 hrs. It is hoped that the President, Lord Runciman, will be in the chair.

INDUSTRY SUPPLIER. — In the Classified Directory of Suppliers to the British Aircraft Industry published in our previous issue the name of W. Wilson and Sons (London), Ltd., was inadvertently left out of the Basic Metallic Materials section. This company, at 114 Nightingale Road, London, N.22, is a major stockists of aluminium and aluminium alloys in sheets, strips and extrusions of all kinds.



PUNCH PACKER. — This 80-ton solid-propellent rocket engine, developed by the Aerojet General Corporation, has produced a thrust of nearly 500,000 lb. for 87 sec. It was static-fired on Aug. 26 at the company's test-site at Sacramento, Calif.

REPEAT TRAINER ORDER.—The College of Air Training, Hamble, has ordered a second General Precisions Systems Flight Procedure Trainer.

UNMINUTED. — An experimental Minuteman ICBM, being fired for the first time from an underground "silo" at Cape Canaveral, failed in spectacular fashion on Aug. 30. Flame and smoke burst from the 90-ft. "silo" as upper staging of the missile emerged to fall back on the launching site. Meanwhile, the first stage, still below ground, shot flames 100 ft. into the air.

MORE RANGERS.—Four additional Ranger spacecraft have been added to the existing Ranger Lunar Exploration Programme. NASA announced on Aug. 29. This brings to nine the number of Ranger probes to be launched in this phase of the U.S. programme to explore the Moon. The new order will involve Ranger spacecraft which will relay to Earth high-resolution TV pictures up to the moment of impact.

RED STREAK.—Sergei Ilyushin was quoted by Moscow Radio on Aug. 21 as saying that Russian air transport will carry passengers at "cosmic" speed in the not-too-distant future. Passenger rockets would replace present types of aircraft to take people to any part of the globe, he said. It would be the cheapest and most convenient means of transport.

NEW DISCOVERER.—Another Discoverer satellite was launched from Vandenberg A.F.B., Calif., into a near-polar orbit on Aug. 30. It carried a 300-lb. re-entry capsule.

BURNT UP.—NASA announced on Aug. 29 that the Explorer XIII satellite, launched four days before from Wallops Island, Virginia, has re-entered the atmosphere. As explained in our article, "A 'Space-Dust' Satellite" (p. 338), it had been launched into a more eccentric orbit than had been planned.

ASTRO-STOVE.—The U.S.A.F. has developed a food warmer powered by solar energy "which will enable future astronauts to serve hot meals."

Commercial Aviation Affairs

TRANS-PACIFIC RECORD. — On Aug. 9 a Qantas Boeing 707-138B (turbofans) made the fastest flight by a commercial airliner between San Francisco and Sydney. The 7,600-mile Pacific crossing was completed in a flying time of 13 hr. 44 min. via Honolulu and Nadi (Fiji). This aircraft is the second of four new turbofan 707s for Qantas, all of whose existing 707s are being modified to turbofan power.

CINE-CAMERA DETECTION. — B.O.A.C. has used a cine-camera mounted under the fuselage of a Comet 4 in order to discover the cause of tyre-abrasion trouble on landing. It was found that—as suspected—the rear pairs of wheels in the main undercarriage bogies were lifting when the nosewheel touched, and braking action sometimes caused these wheels to lock and the tyres to "scuff" or burst. The landing technique has since been modified to deal with the problem.

AIR MAIL JUBILEE.—B.E.A., in collaboration with the British Air Mail Society, will operate a special helicopter flight at 11.48 hrs. next Saturday (Sept. 9) to commemorate the first U.K. domestic air mail flight—between Hendon aerodrome and Windsor Great Park—in 1911.

A.T.C. CONFERENCE.—The constitutional conference of the European Federation of Air Traffic Controllers Associations (EFATCA) will be held in Amsterdam on Oct. 19-20. The federation was formed as a result of a resolution at a meeting of associations at Frankfurt/Main in November, 1959. Associations from 13 countries will be represented at the conference.

B.O.A.C. TO MANILA.—On October 31, B.O.A.C., subject to approval, will open its first direct service between the U.K. and the Philippines. It will be operated twice weekly by Comet 4s flying on the London-Singapore-Tokyo route.

DUBLIN AIR TRAFFIC.—Following representations from T.W.A. and Pan American—both of which wish for Dublin traffic rights on North Atlantic services—the U.S. Government has asked the Irish Government for an early review of the present bilateral air agreement.

MORE MONEY.—Air Safaris of Gatwick tell us that a proposed increase in their authorized share capital from £65,000 to £100,000, agreed at a board meeting last June, has now been fully taken up.

GHANA VISCOUNTS.—The first of three Viscount 838s for Ghana Airways is due for delivery later this month. These Viscounts are laid out for 52 passengers—with 14 first-class and 38 tourist seats.

BRAZILIAN MERGER.—The realignment of airlines in Brazil (see our issue for Aug. 17) involves the purchase by Varig of REAL Aerovias. In May Varig purchased a 50% interest in Aerovias Brasilias, the international division of REAL. The latest deal is subject to confirmation by the Brazilian government.

NEWARK JETS.—Subject to a PNdB restriction of 112, jet aircraft can now be operated into Newark by American Airlines and United Air Lines. Relaxation of an earlier ban has been approved by the P.N.Y.A. and the Governor of New Jersey. Initially, Boeing 720Bs and Caravelles will operate into Newark.

ELECTRA MODS. COMPLETE.—All Lockheed Electras have now been modified for operation at normal design cruising speed. The last aircraft from the Burbank modification line was Ansett-A.N.A.'s third Electra, which was delivered in July.

ATLANTIC CARGO RATES.—The new IATA Atlantic cargo rates come into force on Sept. 1. Details were given in our issue of May 25, p. 578. The emphasis is on reductions for bulk shipments.

AGENTINE CARAVELLES.—Aerolineas Argentinas has ordered three Caravelle VIs, wih an option on three more. The total of Caravelles now on order is 122.

CHICAGO CRASH.—In the early hours of Sept. 1 (about 07.00 hrs. G.M.T.) a T.W.A. Super Constellation crashed about three minutes after take-off from Midway Airport, Chicago, on a flight from Boston to San Francisco. The aircraft crashed and burnt about 12 miles from Midway in a sparsely populated residential district west of Chicago. There were no survivors among the 71 passengers and six crew.

News About People

PERSONNEL MANAGER. — Mr. Jack Gregory has been appointed manager, personnel services, with British United Airways. He was previously assistant general secretary of the Merchant Navy and Airline Officers Association.

ULTRA EXECUTIVES.—In order to clarify the position and responsibilities of senior executives Ultra Electronics has appointed Dr. F. W. Stoneman as executive director, sales and engineering, Mr. A. Sadler as chief engineer and Mr. D. S. MacIntyre as general sales manager.

B.O.A.C. L.A.P. APPOINTMENTS.—Mr. G. A. K. Matheson has been appointed assistant to manager, London Station, and Mr. A. J. Cutting has been appointed assistant passenger superintendent. Mr. Matheson joined Imperial Airways in 1939 and Mr. Cutting joined B.O.A.C. in 1943.

NEWS FROM CANADA.—Mr. C. M. Brant, chief of technical and policy coordination in the Canadian Department of Transport's telecommunications branch, has been appointed deputy director, air services, effective Sept. 5. Mr. Brant succeeds Dr. T. G. How as the third and last appointee in a six-year programme under which senior department officers have received special training. Dr. How returns to his position of director of the Transport Department's Vancouver air services region.

INDUSTRY MANAGER.—Responsibility for the control of the specialized industry groups within the sales organization of Aircraft-Marine Products (Great Britain), Ltd., has been given to Mr. R. T. Gladwell. He is appointed industry group manager. Mr. Gladwell joined A.-M.P. in 1956 from English Electric with whom he worked on guided weapon projects.

BELLING-LEE CHANGES.—Three new managerial appointments announced by Belling and Lee, Ltd., are Mr. B. M. Lee, formerly director and industrial division manager, as assistant general manager, Mr. J. W. F. Golley, general works manager, as works director; Mr. J. R. Turrill has joined the company as sales manager.

Air Transport

Automating Orly A.T.C.

AN IBM 650 Ramac computer is being installed at Orly for experimental use in automatic flight plan processing. The computer will automatically process flight plans of aircraft under Orly control, to produce flight strips giving E.T.A.s at fixed points along the route.

Information stored in the computer's memory drum will be used to predict potential conflicts of flight paths, and a printed message indicating any such conflicts will be provided. Corrective action suggested by the controller will be checked by the computer to ensure that it does not produce further conflicts.

The system is expected to be in use experimentally before the end of this year, and eventually some form of integration with the military defence system is envisaged.

Summonses Against Falcon

LAST week seven summonses, alleging contraventions of the Civil Aviation Act, 1949, or the Air Navigation Order, 1960, were issued against Falcon Airways and/or Capt. M. Kozubski. They concern a North Atlantic operation between Mar. 25 and Mar. 30 this year.

Summarized, the summonses relate to the following allegations:—

The installation of aircraft radio in a manner not approved by the M.o.A.; the failure (on two counts) of Capt. Kozubski to satisfy himself, as commander of the aircraft, that the navigation equipment was in a fit condition for use; the flying of an aircraft over the Atlantic without the provision of dinghies sufficient to accommodate the number of people on board; the flying of an aircraft when not provided with the navigation equipment necessary for its intended flight and when not provided with radio apparatus capable of enabling the aircraft to be navigated on the intended route; and the failure to maintain radio apparatus in a serviceable condition.

Meanwhile the Ministry of Aviation has given permission for inclusive tour flights by Constellation OE-IFA, chartered by Falcon from Aero Transport and flown by Capt. Kozubski and a British crew. This permission was refused in July and the Ministry issued an explanatory statement (see our issue of Jly. 27, p. 98).

A Freight Airlift

MORE than a dozen airlines—and MATS—were engaged during August in a massive transatlantic freight operation representing in weight nearly 2.5% of the total freight traffic over the North Atlantic in 1960. Briefly mentioned in our issue for Aug. 24, the airlift was arranged by the Union Carbide Chemicals Co. to provide the fastest possible delivery of 2.25 million lb. (1,120 tonnes) of Sevin insecticide required to combat a plague of "army worms" which are attacking the cotton crop in Egypt.

The United Arab Republic placed its $2 million contract for the insecticide on Aug. 4, and deliveries from New York International began on Aug. 6, with the chemical packed in 100-lb. barrels. Most of the shipments have been carried by commercial airlines, at an average rate of about 160,000 lb. a day. The scheduled freight operators on the North Atlantic have had insufficient capacity available to participate on a large scale, although K.L.M., Pan American and Alitalia have flown a number of charter flights with DC-7Fs and L-1049s, either direct to Cairo, or to European terminals for onward shipment.

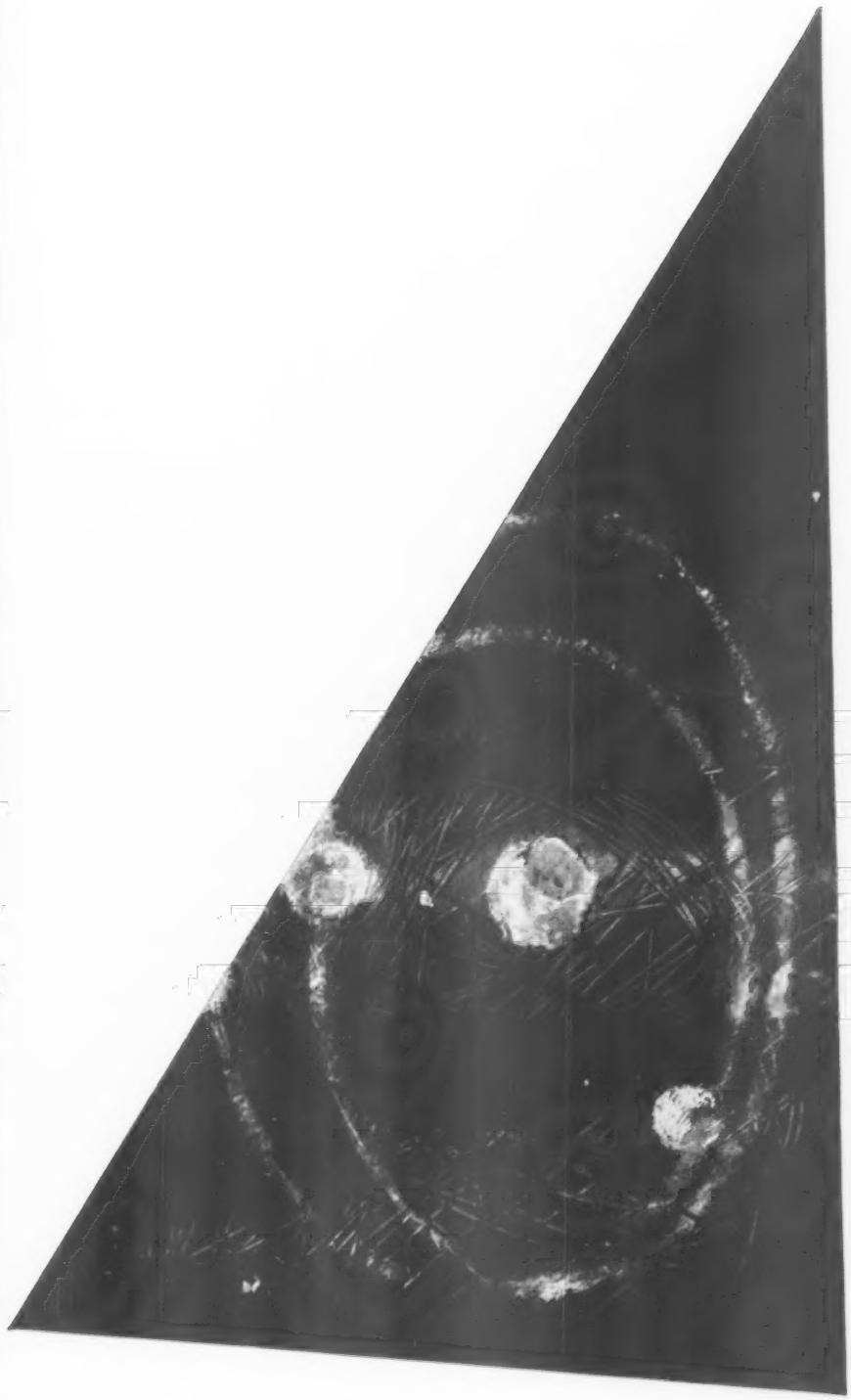
Many regular DC-8 and Boeing 707 passenger services from

(*Continued on page 299*)

DATE WITH A DREAM.—*The Wall Street Journal* recently described air cargo as "the unglamorous business with the dream-filled future." Here is one of Flying Tiger Line's Canadair CL-44 swing-tail freighters—which may help to turn the dream into a reality.

Plessey

one of
the world's
foremost
manufacturers
of aircraft
systems
and
equipment



Plessey aircraft systems and equipment cover every type of aircraft, missile and aerospace application, ranging from complete power generation systems for the biggest jetliner to the smallest relay or connector.

Plessey research, development and production are constantly geared to the requirements of aircraft and engine designers, often contributing significantly to totally new engineering concepts.

Throughout the world, both civil and military aircraft manufacturers draw continuously on the experience of Plessey, turning naturally to an organisation which covers the whole field of pneumatic, hydraulic, electrical and mechanical systems engineering. ▷

F

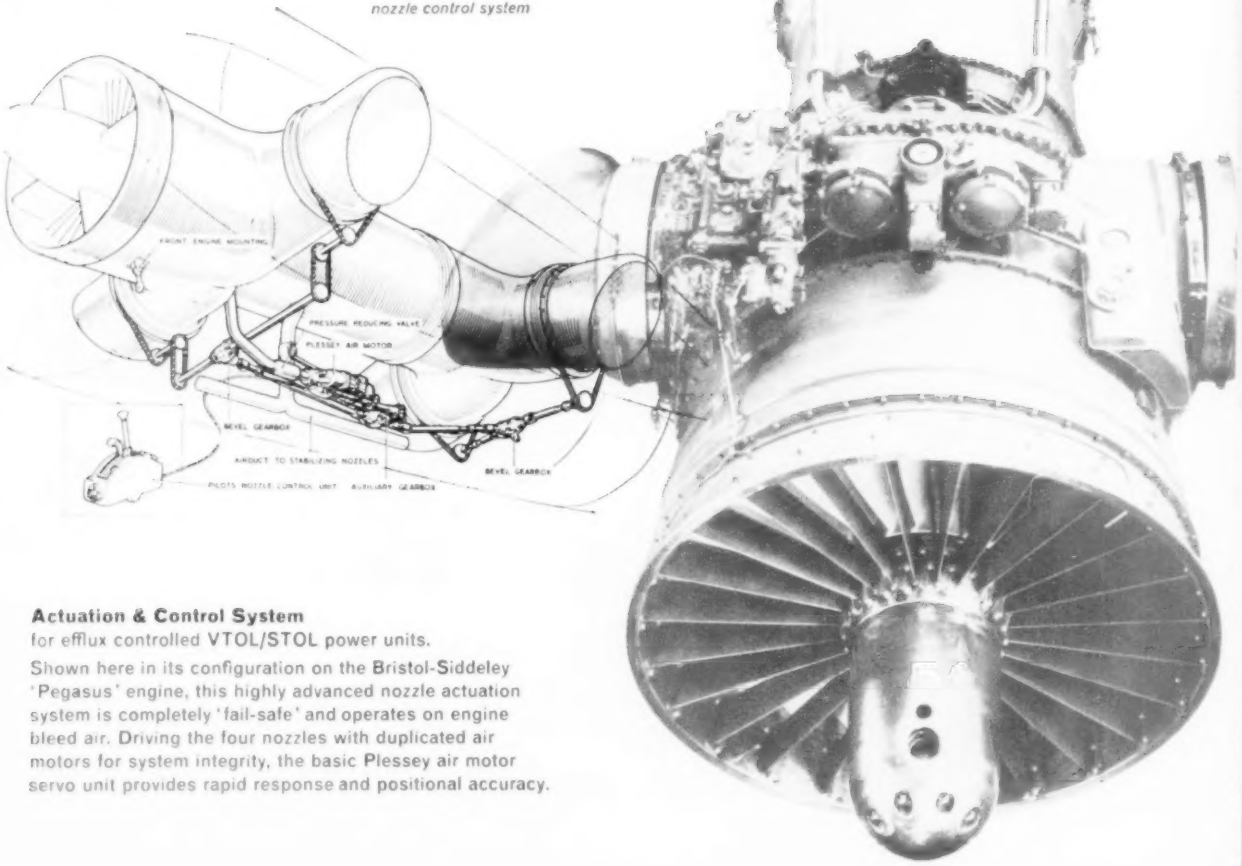
JUST THREE EXAMPLES OF Plessey ADVANCED SYSTEMS

Plessey systems are continuously specified for their dependability, ruggedness—and sheer ability to cope with today's problems of higher speeds and tighter operational requirements. Plessey systems start the Canberra PR9, the Lightning, and seven marks of Hunter. As part of an impressive contribution to the Vickers VC10, Plessey provide the complete generation system; whilst on the new BAC 'One-Eleven' not only the multichannel generation system, but the constant speed drives and starter system are Plessey engineered. In the VTOL field—for the Hawker P 1127—Plessey again provide the constant frequency generation system, whilst Plessey pneumatics provide both muscle and the means of precise control of the swivelling nozzles.

Whenever a new concept, a new aircraft is born—

1 PNEUMATIC

Pneumatic actuation and nozzle control system

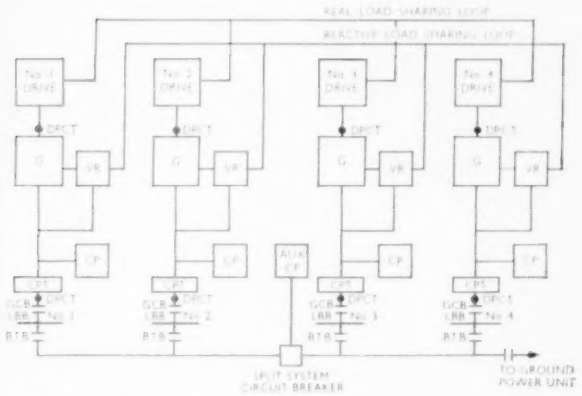


Actuation & Control System
for efflux controlled VTOL/STOL power units.

Shown here in its configuration on the Bristol-Siddeley 'Pegasus' engine, this highly advanced nozzle actuation system is completely 'fail-safe' and operates on engine bleed air. Driving the four nozzles with duplicated air motors for system integrity, the basic Plessey air motor servo unit provides rapid response and positional accuracy.

2 ELECTRICAL

Schematic is of a typical a.c. generation system for a four-engined aircraft.

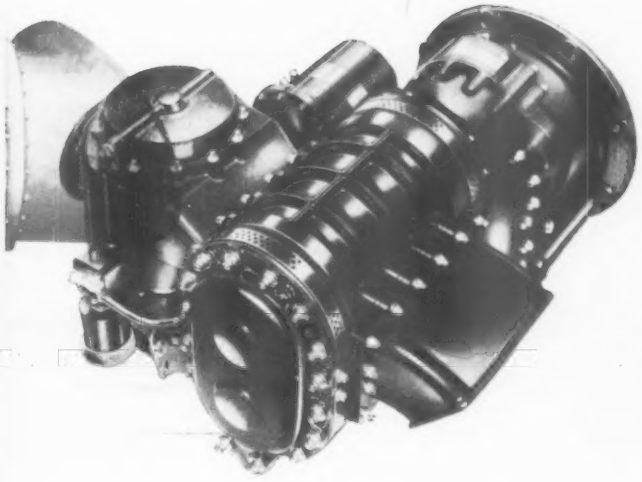


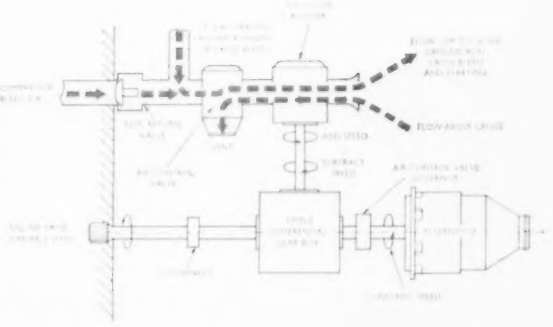
A.C. Generation Systems
–ranging from 4 kVA to 40 kVA per channel.

Plessey can supply a.c. generation systems incorporating brushless alternators of extremely advanced design, and associated control equipment which largely comprises solid-state elements. Illustrated is a schematic arrangement of a typical a.c. generation system for a four-engined aircraft. Full provision is made for generator paralleling, and for instant off-loading and load transfer under emergency conditions.

Plessey aircraft systems play a vital role.

3 MECHANICAL





Constant Speed Drive/Starter System–offers these important functions to the civil or military aircraft designer in one compact, highly developed unit:

Constant speed output–giving frequency control (at 400 c/s) within ± 1 c/s, and an overall efficiency in flight better than 90%.

Flight emergency services–in the event of engine failure, vital supplies maintained using cross-bled air from other engines.

Ground running–of complete aircraft electrical and hydraulic systems without running the main engines.

Air starting–of engines by simple ground connection of air supply–or self-contained by means of an APU or stored air.

High temperature screw jack, transmits thrusts up to 1,000 lb.

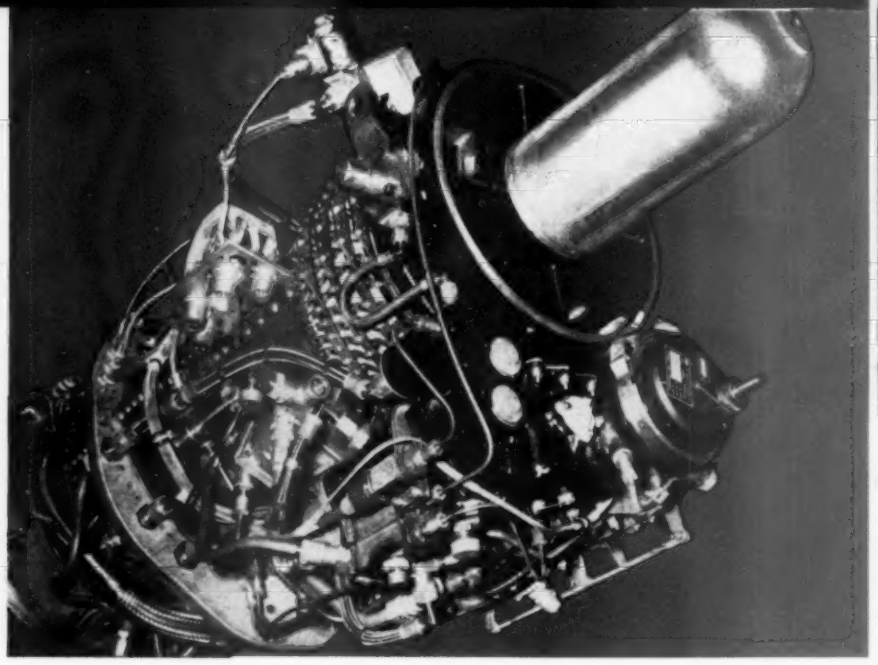
AND NOW Plessey AT 400°c

Continuous development of Plessey aircraft equipment has enabled operational temperature limits for many components and units to be considerably extended.

Already firmly established as a supplier of high temperature flexible metallic tubing and electrical connectors (up to 1100° C test), Plessey can now make available, for example, motors, actuators and relays which maintain performance up to 250° C; synchros (from the Plessey Associate Company, Ketay Limited) up to 150° C; and specific types of screw jack up to 400° C.

High temperature actuator for use up to 200° C.

The De Havilland 'Gyron' engine is fitted with both high temperature 'Plessiflex' and a Plessey preformed ignition harness.



THE PLESSEY COMPANY LIMITED

AIRCRAFT EQUIPMENT GROUP, Ilford, Essex, England. Telephone Ilford 3040

Overseas Sales Organisation: PLESSEY INTERNATIONAL LIMITED.

A106

ALASKAN TURBOJET.—This Convair 880-M, seen taking off at San Diego during its functional and reliability test programme, is now in service with Alaska Airlines on its trunk Seattle-Fairbanks-Anchorage route.

Air Transport . . . .

New York to Amsterdam, Copenhagen, London, Frankfurt and Rome have been carrying the Sevin barrels as fill-up freight, and in a number of cases passenger aircraft returning empty to Europe have carried the barrels in the passenger seats. On one such flight, a S.A.S. DC-8 lifted 37,205 lb. to Copenhagen in 285 barrels. Some Swissair passenger flights have carried Sevin barrels in unoccupied passenger seats in the economy-class cabin.

So urgent was the UAR's need of this insecticide, that MATS was asked to participate in the early stages of the lift and, on Aug. 12/13, four C-124s and five C-118s and C-121s carried 230,000 lb. to Europe. The UAR will be charged for this operation. Among the airlines which have participated, in addition to those mentioned above, are Irish International, Sabena, Air France, Lufthansa, Air India, Seaboard and President.

Never Mind the Weather

APART from passing references to "radar-equipped airliners which fly above the weather," meteorological forecasting has never been a pet subject in airline advertising circles. Perhaps it is considered to be a topic which is best left alone, because any mention of it immediately makes the prospective passenger think of flight in dark turbulent stormclouds. Safety is another similarly neglected subject.

Now Eastern Air Lines have embarked on an advertising campaign about their weather forecasting skill under the heading: "There's a gleam in Eastern's weather eye." They mention that their research activity has resulted in 30 awards to the airline—probably more than those awarded to all other airlines combined. Under Brigadier General Joe George, Eastern's meteorologists have evolved new procedures to keep pilots up to date through a unique Weather Department-to-pilot radio link.

It is instructive to learn just how serious the U.S. airlines are about weather forecasting. Eastern maintains a staff of 34 professional meteorologists, each of whom averages more than 15 years of experience. Five other major U.S. airlines now have their own weather departments—which suggests that airlines relying only on U.S. Government forecasts are missing something.

All the same it is pertinent to comment that if any British airline maintained a weather department as big as Eastern's it would be accused of extravagance—even if it *did* provide a useful subject for advertising.—D.N.M.

Stavanger Accident Report

A PRELIMINARY statement from the Royal Norwegian Permanent Aircraft Accident Commission on the disaster near Stavanger was issued on Aug. 25. This gave the facts relating to the accident (on Aug. 9), so far as these had been established, but could offer no explanation for the fact that the Cunard Eagle Viking was about 16 naut. miles to the east of the approach pattern which it appeared to have been following. The final report is not likely to be completed for several months.

The aircraft had been following the normal ILS let-down procedure for runway 18 at Sola Airport, Stavanger. It had been cleared by central control to descend from 8,600 ft. to 4,000 ft. on a heading of 005° which would take it over the airport and the outer marker before making a procedure turn back on to the 185° ILS approach heading. When still south of Sola and descending through 5,000 ft. it had been taken over by approach control.

There had been a conventional series of RT conversations between air traffic control and the aircraft, with normal altitude

CAMBRIAN BASE.—On Aug. 28 work was started by Cambrian Airways on its new engineering and administrative building at Cardiff (Rhoose) Airport. As from April next year Cambrian will undertake its own maintenance on the present DC-3 Pionair fleet (leased from B.E.A.) and, later, on turboprop equipment to be introduced in 1963.

Photograph copyright "The Aeroplane and Astronautics"

Air Transport . . . .

and position reporting, and with weather and barometric information given by the tower. At 16.20 hrs. local the captain reported that the aircraft had passed over the outer marker (on outward section of its pattern before making a 180° procedure turn on to the final approach heading) and was instructed to report when passing the beacon on its final approach. Just before 16.21 hrs. the aircraft asked for a QFE (barometric pressure at Sola) and it was given by the tower at 16.22 hrs. This was the last radio contact; from 16.29 hrs. onward the tower called the aircraft repeatedly without receiving an answer.

The Viking struck high ground (Holteheir, 1,750 ft.) at a point about 18 naut. miles north-east of the airfield (or about 16 naut. miles east-north-east of the nearest point of the approach pattern being used). Investigations suggested that it had struck while flying on a south-easterly heading and with its undercarriage and flaps up. The time was "somewhat earlier" than 16.29 hrs. local.

Following the normal let-down pattern, the Viking would have been at 2,000 ft. when over the airport, and would have started a descent when over the outer marker on the outward leg. It would have passed through 1,500 ft. during the second half of the procedure turn (see diagram) and would have started its final descent from 1,300 ft. over the outer marker.

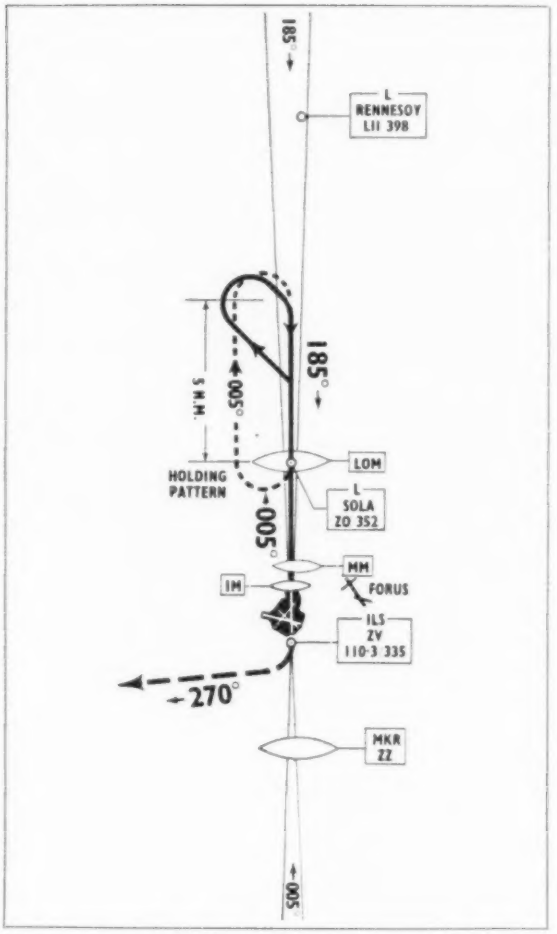
There had been some misunderstanding at an earlier stage during the let-down, when the crew gave an estimated arrival time at Rennesöy beacon after being asked at 16.18 hrs. for an E.T.A. over the outer marker. This beacon is some 10 naut. miles north of the marker and the tower therefore suggested that the pilot meant the outer marker. To this he replied, "Roger," leaving the situation slightly obscure. But estimates suggest that he must, in fact, have meant the outer marker and not the beacon.

The weather (at 15.54 hrs. local) was given as: wind, 25 knots, 210°; visibility, 10 km. (5 naut. miles); cloud, four-eighths at 500 ft. and five-eighths at 2,500 ft.

Asked in Oslo whether the flight crew had been familiar with the route and the approach pattern, Col. J. K. Christie, the commission's chairman, is reported to have said that the captain had not been to Sola before and it had not then been established whether the co-pilot had been there.

There is, in fact, no specific requirement laid down in this matter. The Air Navigation Order, 1960—Tenth Schedule (Public Transport: Operational Requirements) Part B, 1 (5)—says:—

"The pilot designated as commander of the aircraft for the flight shall within the relevant period—(i) have demonstrated to the satisfaction of the operator that he has adequate knowledge of the route to be taken, the aerodromes of take-off and landing, and any alternate aerodromes . . . (ii) have been tested as to his proficiency in using instrument approach-to-land systems of the type in use at the aerodromes. . . ."



The International Aeradio chart of the ILS approach pattern for runway 18 at Sola Airport. The aircraft struck high ground about 12 naut. miles east of the radio beacon at Rennesöy, or about 18 naut. miles north-east of the airport.

Helicopter Accident Report

A FATIGUE fracture of the main rotor blade is recorded by the Civil Aeronautics Bureau as the reason for the crash of a Chicago Helicopter Airways' Sikorsky S-58C on Jly. 27 last year. The accident, in which the 11 passengers and crew of two were killed, was the worst in the history of scheduled passenger-carrying helicopter operations. At the time of the accident, a little before midnight, the S-58 was making its seventh scheduled flight that day between Midway and O'Hare Airports. The route is 17 naut. miles in length and is over open areas suitable for emergency landings in autorotation.

From a reconstruction of the sequence of events it was found that one of the four main rotor blades had snapped, the outer 19-ft. portion being found 2,890 ft. from the main wreckage. The tail cone, with the tail rotor attached, broke off as the helicopter fell and was found 990 ft. from the main wreckage.

When it had been established by the C.A.B. that the main blade failure was the result of metal fatigue, an extraordinarily thorough investigation was made of the relevant design standards and procedures, manufacturing standards and procedures, and service conditions and practices. The blade which failed was manufactured by Sikorsky in October, 1956, and was repaired in June, 1958, after it had been subjected to a "quickstart." This repair involved the replacement of the 14 inboard pockets. The fatigue crack was found to have started from an area of sandpaper scratches made during original manufacture before the pockets were bonded to the spar, at the surface of the lower external back-wall radius of the spar. It then progressed up the back of the spar, and along the lower surface for a distance of about five inches.

At the time of the accident, the blade had a total service time of 1,786 hr. 6 min. out of the F.A.A.-approved life for such blades of 2,450 hr.

Close attention was given to the surface finish applied to the blade, but this was eventually discounted as a major factor. Greater concern is shown in the C.A.B. report over the failure of the approved inspection procedures to discover the crack before it was too late. C.H.A. makes a daily preflight check; a No. 1 inspection at 20 hours; a No. 2 at 55 hours; a No. 3 at 105 hours; and a No. 4 at 210 hours. The preflight, No. 1 and No. 2 checks include a visual inspection of the blades *in situ*, for "dents, scratches, cracks, corrosion, and damage to spar pockets and trailing edge." The No. 3 check is similar but the blades are first cleaned with a dry rag. For the No. 4 check, the blades are removed and washed with soap and water.

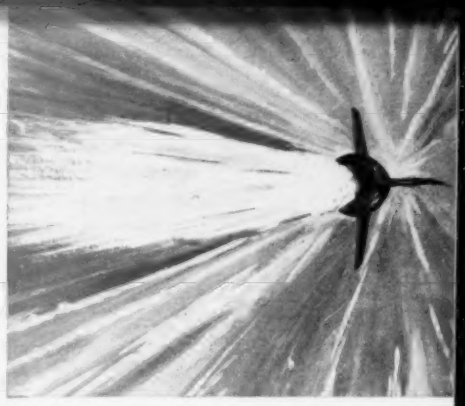
In the Board's opinion, the procedure at Nos. 1, 2 and 3 checks was "not conducive" to crack detection on the lower surface in the area where the fracture occurred, but a No. 4 check was adequate to discover such a crack. It was therefore concluded that the crack was not visible at the last No. 4 inspection, 68 hours before the accident. Because a catastrophic main blade failure is therefore deduced to have developed from a crack in less than 68 hours, the Board recommends that No. 4-type checks should occur at shorter intervals.

The Board also suggests that design standards need to be reconsidered with a view to a more conservative design approach, particularly when the "safe life" philosophy is used.

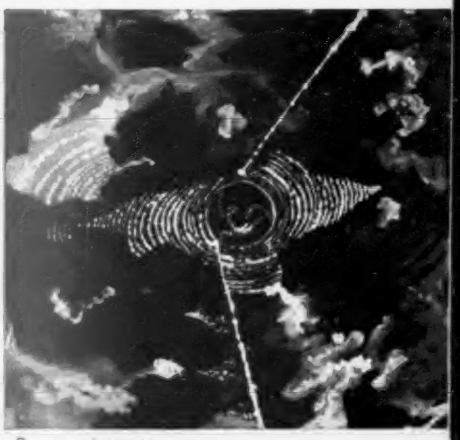
Since the accident the approved life for S-58 blades in commercial operation has been reduced from 2,450 hours to 1,000 hours. This is the total permitted life of the blade, not an inter-overhaul period.

VICTOR

vigilant



Missile carrier



Reconnaissance

Bomber

While the world sleeps or works or plays, Victors are ready—waiting to fill any of their three roles as missile carriers, reconnaissance aircraft or nuclear bombers.

A single sortie by four Victors can map the whole of a continent.

At three minutes warning Victors can be airborne, retaliating against an aggressor country, each carrying a weapon more powerful than a million tons of TNT.

In the face of such a deterrent sanity decrees that global war is now unthinkable.

HANDLEY PAGE · RADLETT · LONDON · READING

ROLLS-ROYCE

Since the 1960 S.B.A.C. Display, Rolls-Royce has continued to grow in size and activities, and its Aero Engine Division alone now employs 40,000 people of whom 9,500 are engaged on research and development work. In total the company has over 49,000 employees.

Exports by the company last year rose to the record level of more than £53m., largely through the sale of aero engines and spares. With 27 million hours of experience in civil and military operation Rolls-Royce turbine engines are now in service with or on order for 95 airlines and 32 armed forces around the world.

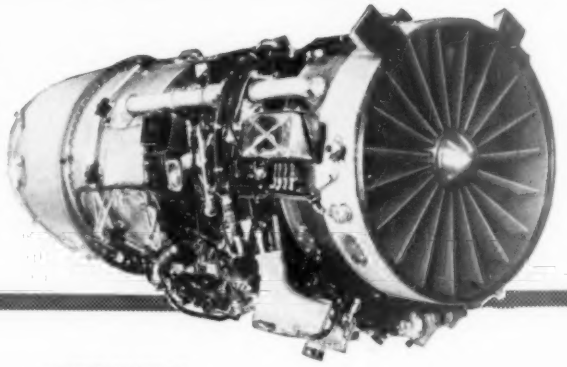
Highlights of progress with Rolls-Royce aero engines in 1961 are given here.

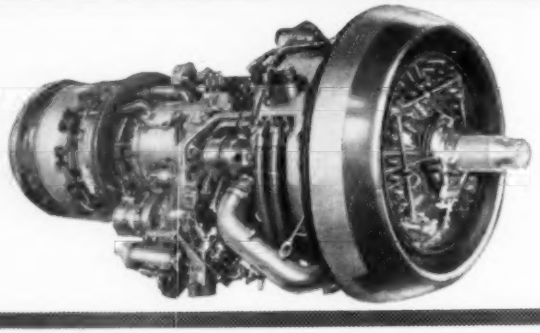
CONWAY

World record overhaul life for by-pass jets — 1,700 hours.

Development running of 20,250 lb. thrust R.Co.42 started.

Increased airline orders for VC.10 and Super VC.10.





TYNE

Introduced into airline service with BEA, TCA, Seaboard World Airlines and the Flying Tiger Line.

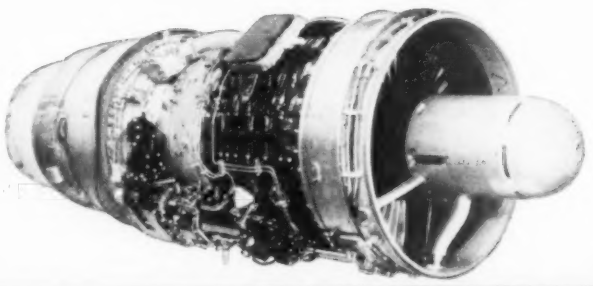
Roll-out of prototype Breguet Atlantic NATO maritime reconnaissance aircraft.

AVON

World record overhaul life for turbo jets — 2,900 hours.

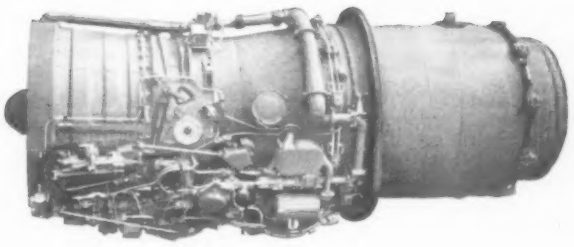
First British turbo jet on domestic services in America in UAL Caravelles.

Latest military version entered service with R.A.F. in Lightning.



ROLLS ROYCE

ROLLS-ROYCE · AERO ENGINES · MOTOR CARS · DIESEL AND



SPEY

Selected to power the new BAC One-Eleven transport.

Government development contract for military version to power Buccaneer S.2.

Ground running trials in the Trident completed.

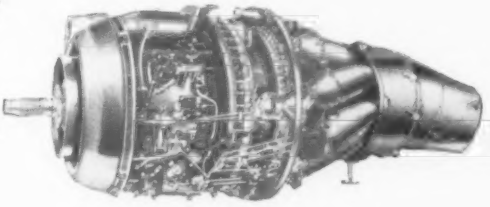
DART

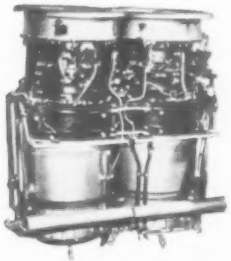
Highest overhaul life ever reached by any aero engine — 3,200 hours.

Entered service in Argosy with Riddle Airlines in America.

Entered service in Herald with Jersey Airlines.

Received joint ARB/FAA type certificate at 3,030 e.h.p.





JET LIFT

Development running of RB.145 jet lift engine started.

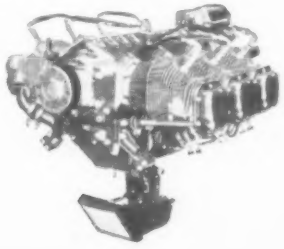
Joint development of RB.162 jet lift engine with France and Germany announced.

Rolls-Royce jet lift engines specified for military VTOL and STOL projects.

LIGHT AIRCRAFT ENGINES

Engines manufactured by Rolls-Royce under licence from Continental Motors scheduled for delivery 1962.

Several new British aircraft to be powered by Rolls-Royce Continentals.



ROCKET MOTORS

Complete Rolls-Royce propulsion system test fired under Blue Streak vehicle at Spadeadam.

Rolls-Royce founder member of British Space Development Company.

PETROL ENGINES · ROCKET MOTORS · NUCLEAR PROPULSION

NOW IT'S PYE LING

A NEW FORCE IN ENVIRONMENTAL ENGINEERING

Pye, one of the foremost names in British electronic engineering, has now consolidated the achievement of its subsidiary, W. Bryan Savage Ltd, and at the same time broadened the scope of its activities by bringing it into association with the great Ling Temco Vought Corporation of America to form a new Company, PYE-LING LIMITED. This organisation will produce a range of Vibration and Fatigue Testing equipment that will be unmatched throughout the world for comprehensiveness and quality. The resources and experience of both the Pye Group and Ling will ensure that the British Aircraft Industry will have immediately available the precise equipment it requires for the proving of every type of component.

The Liquid Cooled Vibrator illustrated has a Thrust Rating of 30,000 lb. and is the largest of a comprehensive range which starts at 25 lb.

PYE LING
VIBRATION ENGINEERS

PYE-LING LIMITED, 7-8 DALSTON GARDENS, STANMORE, MIDDLESEX

AP. 12

"Graduates" for Maintenance

Some months ago we drew attention to a particularly important aspect of airline maintenance engineering which drew some informative correspondence. Here, PETER F. MURRAY, *general secretary of the Society of Licensed Aircraft Engineers, enlarges on this subject.*

THERE are two quite distinct sides to airline engineering, the development branch and the production or maintenance branch. The first of these is closely comparable in its staffing and working to the development teams of aircraft and aero-engine manufacturers. It has need both of sound theory and wide practical understanding of how the structures, systems and mechanisms of an aircraft behave in service under commercial conditions. The university graduate and the engineer trained in traditional manner through apprenticeship, experience and self-tuition both have a valuable part to play, and in almost every airline today engineers from both sources contribute to this work.

However, on the production side, that is the department of an airline engineering organization concerned with making available to the operations department the maximum number of safe and reliable flying hours per aircraft, the story is somewhat different. Here practical experience is paramount and, so far, few university graduates have been willing to put in the years of work necessary to give them the practical experience required.

This is understandable when one compares the financial rewards available to newly graduated engineers entering other fields with the rewards during the 10 years or more which they would have to spend gaining practical experience in aircraft maintenance engineering. Even with the most intelligent men, the complexities of modern airliners are such that the overall background and experience of fault diagnosis and rectification necessary to a Station Engineer is rarely achieved more quickly.

In airline engineering, each new generation of aircraft tends to be built of different materials, to embody new principles and to have cybernetics radically different to its predecessors. This means that aircraft maintenance engineers from the highest to the lowliest have to undergo continuous retraining and re-examination throughout their careers. Yet, even so, for the sake of safety, each new type of aircraft has to be handled in the light of the experience accumulated in maintaining safety and reliability on its predecessors. All this despite the narrow engineering safety margins provided in the design of aircraft in comparison with the design of other transport vehicles on land or sea.

It will be appreciated from the foregoing that airline engineering in all its departments has need of highly intelligent, educated and knowledgeable men, but that their training and qualifications present severe problems, especially on the production side.

Education Trends

In the past, the recruitment of highly intelligent men for this work was not so difficult. Only a small proportion of young men got to university. Most intakes of apprentices into the R.A.F. R.N., and the aircraft industry included a good number of young men of high calibre and potential. Many of them subsequently obtained their education "the hard way" and now manage most of the country's airline engineering departments.

Nevertheless, the development of public education in the United Kingdom is providing more and more places in the universities and technical colleges. In coming years most of the young men of high I.Q. will have opportunity of studying at such establishments. Yet, having graduated through any contemporary university courses, their immediate knowledge and capabilities are of little or no use in most airline engineering functions until leavened and developed through several years of practical experience.

Men of the innate intelligence and with the thinking capacity represented in the university graduate are vital to the continuance and development of airline engineering. Yet much of the academic training received in contemporary aircraft engineering courses at universities and technical colleges is only remotely concerned with the problems of airline engineering. It takes little account of the practical experience vital in every stratum of such employment, without which both safety standards and economics rapidly deteriorate.

In endeavour to get to grips with this problem, the Society of Licensed Aircraft Engineers some 12 years ago undertook a very extensive investigation into the nature of the airline engineer's tasks, his present and desirable educational attributes and the methods used or proposed to qualify him. In part this research provided a report requested by the Ministry of Education and, in part, it determined the Society's membership structure and qualifications.

It was found that while an airline engineer requires a very wide knowledge of very many branches of science, engineering, mathematics, and legislation, ordinarily he does not need very deep learning in each branch except in a few development department functions. It is the breadth not the depth of his knowledge requirement that poses his educational problem, especially as this requirement tends to be opposed to the contemporary teaching practices in universities and technical colleges, and to the bents of the teaching staffs therein, most of whom have been educated in traditional manner and have acquired deep knowledge in a limited field.

Future Needs

Having closely examined what had happened in the past, the S.L.A.E. went on in its researches to predict what was wanted in the period 1950-1970. Half that period has now passed, and the situation has recently been reappraised to adjust the Society's work to take into account recent technological advances and the likely trends in the 10 years following 1970.

It has been found that the manning and educational trends of the past 10 years have closely followed that which the Society predicted in 1950. Due to the increasing complexity and physical size of modern airliners, there has been increasing tendency, especially in the corporations, for work in the lower ranks to become more specialized, with fitters being restricted to work on particular components or systems. It has become increasingly difficult to find men having all-round experience for promotion as supervisors, and in the higher echelons there has been an ever-increasing shortage of really widely experienced engineers to fill the key managerial appointments.

Both Corporations have introduced extended apprentice training programmes for engineers, craftsmen and tradesmen, but the numbers qualifying represent only a trickle compared to the demands of rapidly expanding airline operations. Several independent operators have introduced trainee and apprentice programmes.

To considerable extent the former main source of recruitment for airline personnel, ex-Servicemen, has dried up—both the Royal Air Force and the Fleet Air Arm having introduced more incentives for their men to serve for longer periods. Successive aerodrome closures have aggravated the situation, because several hundreds of aircraft engineering employees (mostly in the skilled groups) have left the industry rather than give up their homes and move to fresh locations.

Hence airline engineering is generally short of man-power and the current training programmes are inadequate. Also the changes of technology, and the resultant changes in methods of working, have made it more difficult for men to acquire the extensive all-round experience needed for the exercise of managerial and executive responsibilities in airline engineering. Meanwhile educational pressure is concentrating young men in the highest I.Q. groups into the universities and technical colleges on courses bearing little or no relation to airline engineering.

Careful study by the Society of Licensed Aircraft Engineers of the qualification structure of the profession found need for three distinct but related types of qualification, only one of which existed in 1950. This is the Aircraft Maintenance Engineer's Licence for which the examinations, mostly related to specific types of aircraft, engines or equipment, are conducted by the Air Registration Board under authority delegated (now) from the Ministry of Aviation. The S.L.A.E.'s investigations showed that no other form of practical qualification, whether university degree or corporate membership of the older learned institutions, had real relevance to airline engineering.

Yet at that time, a decade ago, the licence was diminishing in importance and there was nothing to supplement it or take its place. At the same time, the form and nature of the licence examination, while ensuring that licence holders were

thoroughly competent to certify aircraft as fit for flight, did not necessarily act as a suitable yardstick for selecting the future higher levels of airline engineers. Neither did the licence examination offer a suitable training target to encourage young men to undertake limited maintenance functions on the larger types of aircraft.

For all this, the licence continues to be the biggest safeguard to the safety and reliability of airliners because its nature, and the legislation associated with it, places responsibility very personally and firmly upon engineers of proven capability and knowledge in relation to each specific type of aircraft.

Accordingly, the S.L.A.E. set about a triple programme to provide qualifications which would serve as suitable targets for young men entering the profession and which would provide means of selecting the next generations of senior aircraft engineers. First, to provide attainable qualifications for young men entering the profession by apprenticeships, service or civilian, the Society fully backed, and has helped to initiate and develop, the series of aircraft maintenance qualifications set up on three- and five-year course bases by the City and Guilds of London Institute. These are devised to qualify the craftsman and technician, and the syllabuses are such that, provided the apprentice has access to aircraft and workshops at his employer's establishment, the theory is fairly easily teachable within most technical colleges, including those colleges of further education which cater for evening and day-release students.

Secondly, the S.L.A.E. has done a great deal in conjunction with the A.R.B. and the M.o.A. to strengthen the position of licence holders, to adjust the form of the licence examination to contemporary circumstances, and to enhance the value of the licence to its holder to encourage more engineers to qualify by this means. The introduction of the Air Operators' Certificates which controls for the first time the staffing of maintenance organizations (as opposed to inspection organizations) has strengthened the hand of the authorities still further.

Renewed Emphasis on Licences

Today renewed emphasis is being placed by the authorities and the operators upon the holding of licences by a substantial proportion of their inspection and supervisory staffs, and licence holding is now, once again, a requirement for many varieties of employment. In this respect it should be appreciated that a licence on a type cannot be gained without substantial practical experience of aircraft engineering generally and on the aircraft type itself.

In practice a young man entering the profession could expect to obtain his first licence on a major engine, for example, within five years. A further three years would then be spent achieving endorsement for the major airframe to go with the engine.

Thirdly, the Society itself set about providing a professional qualification, specially tailored to the practice of aircraft maintenance engineering and embracing an overall standard of knowledge equivalent to that necessary to obtain corporate membership of the older learned societies; but with the syllabus drawn up in *breadth* and not depth. The result was the A.M.S.L.A.E. examinations set up in 1953 under control of the S.L.A.E. Central Examining Authority.

Since its inception this Authority has sat under the distinguished chairmanship of Air Cdre. Sir Vernon Brown, an Honorary Member of the Society, and has included in its membership chief engineers, chief inspectors and service managers from the airline Corporations, the independent operators and the aircraft and aero-engine manufacturers; senior engineers from the A.R.B., the manufacturers of components and ancillary equipment, training establishments, and guided missile manufacturers.

The Society's researches led to an A.M.S.L.A.E. examination syllabus of unique form with a style of examination having no parallel in other institutions. Emphasis is placed upon an applicant's fundamental knowledge of his profession, upon his specialized knowledge of the branch upon which he has concentrated most, upon his general knowledge of aviation and upon his ability to think logically and to express himself clearly.

However, so specific is the A.M.S.L.A.E. examination in its scope and form, comparison of its requirements with all contemporary qualifications led to the inescapable conclusion that no exemption arrangements could be allowed on the strength of university degrees, existing Dip.Tech., H.N.C., or corporate membership examinations of other institutions. Nevertheless, in the reverse direction, the standards and scope of the A.M.S.L.A.E. examination enabled the A.R.B. to grant holders of the certificates valuable privileges in exemption from various licence examination requirements.

The A.M.S.L.A.E. examination has provided a top grade professional qualification tailored to the requirements of airline engineering. It is attainable by men of high intelligence provided they have acquired very thorough practical experience. Yet all the efforts of universities, technical colleges and other training establishments to devise teaching syllabuses to prepare young men in five years to sit the examination have failed or only succeeded partially. For example, one university dissected the syllabus in endeavour to set up a "sandwich scheme" aimed at giving those top quality students wishing to adopt airline engineering as their career, an apprenticeship, a degree and a professional qualification in five years. The scheme never started because the university came to the conclusion that the training could only be done on an aerodrome where large modern aircraft were being operated, maintained and overhauled, and that the volume of training and experience necessary could not be covered within the normal five years.

Of the several technical colleges which have started A.M.S.L.A.E. courses nearly all have failed, principally because ordinary teaching staff have been utilized, using traditional instructional methods and approaches. On the other hand, the Hatfield Technical College, using professional aircraft engineers as instructors, and closely aligning the courses with practical work programmes at the apprentices' aerodrome, has had reasonable success over those parts of the syllabus which can be taught away from the hangar or workshop, at day-release and evening classes; those students being given this tuition proving themselves exceptional in courses aimed primarily at City and Guilds Certificates in aircraft maintenance engineering.

Men of the calibre of university graduates are needed in airline engineering, yet the old source of such engineers, service and civilian apprenticeships, are tending to dry up as more and more young people go to university. Even assuming that one or more of the universities sets out to provide a degree in airline engineering, the S.L.A.E.'s researches have shown that the subject matter cannot be taught successfully away from major airports and that worth-while qualification in the profession cannot be achieved except through practical experience extending over many more years than university courses. In addition, the comparatively irrelevant nature of many university engineering courses and the unwillingness of graduates to "step down" for several years after graduation in order to get practical experience set a most perplexing problem.

The answer must lie with the airlines themselves, who are the only people with the necessary training facilities, i.e., complete modern maintenance and overhaul bases handling large complex aircraft. Although the editorial in THE AEROPLANE AND ASTRONAUTICS which gave rise to this article mentioned trade union barriers as possible obstacles to extended training within the airlines, it should be remembered that, in a good cause, the trade unions are willing to co-operate and that many trainee flight engineers have been given up to 12 months' experience in the hangars at London Airport and that substantial numbers of engineers from S.E. Asia have been trained "on the job" under the Colombo Plan.

Airline managements have shown themselves capable of negotiating difficult and lengthy agreements with their trade unions. That no agreement has been reached on the practical training of graduate engineers seems perhaps to indicate either lack of awareness of the need to do so or else a certain unwillingness to provide new methods by which good new blood can be started on the road of promotion.

Despite the swing of education to increased numbers of places at universities and technical colleges, the airlines must make every effort to attract into their engineering apprenticeships (over and above their more numerous intake of craft and trade apprentices) a steady stream of boys from the public and grammar schools and the "A" streams of other secondary schools. At the moment, these engineering apprenticeships lead through City and Guilds certificates and H.N.C. to licences and the A.M.S.L.A.E. qualification. Of these stages all except one, namely H.N.C., are relevant to aircraft maintenance.

A Dip.Tech. in Airline Engineering?

Higher National Certificate unfortunately involves the teaching and acquisition of subject matter virtually useless in maintenance except as an academic discipline leading to a paper qualification. The H.N.C. is often thought to be the only general educational yardstick available which does not waste too much of the apprentices' time on non-essentials, but this is clearly a poor criterion for the choice of an educational programme. How much more sensible it would be if it were to be replaced by a Dip.Tech. in Airline Engineering based upon those parts of the A.M.S.L.A.E. syllabus which are amenable to direct teaching. Such a diploma would give the aircraft engineer a qualification recognized and understood nationally as beyond the confines of the profession itself, directly comparable in status and standard to other engineering professions. It would, when combined with the necessary experience, lead him naturally to the unique qualifications of his professional society.

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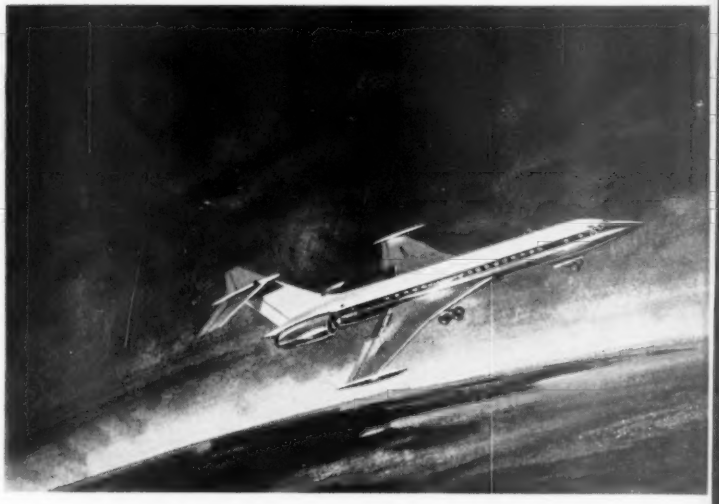

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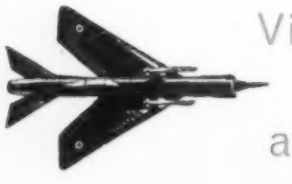

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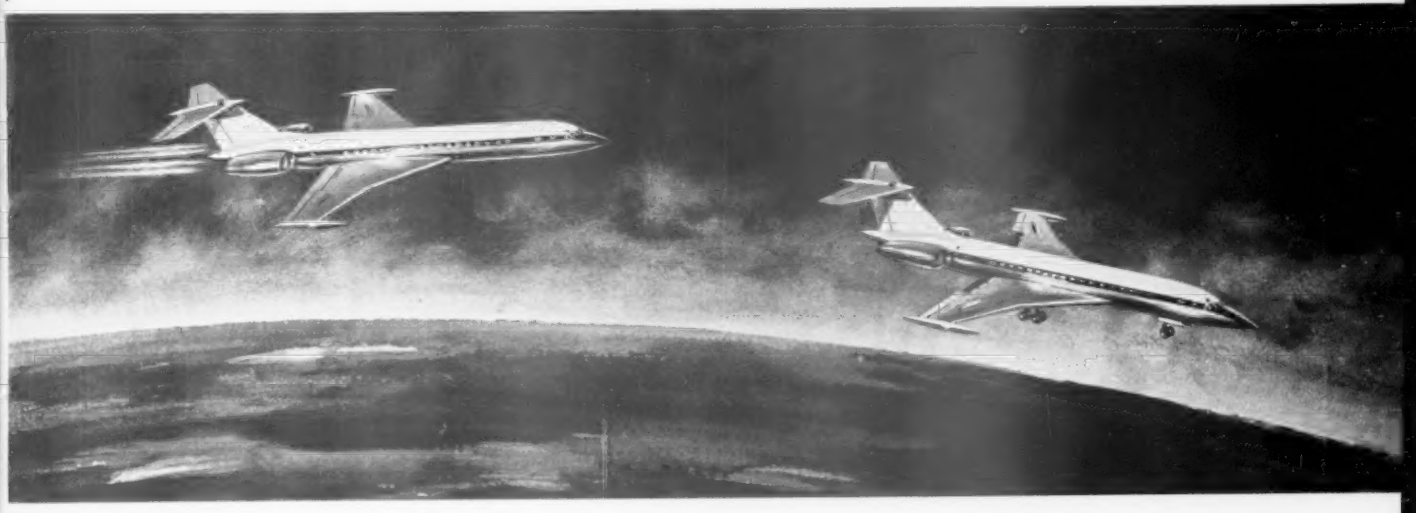

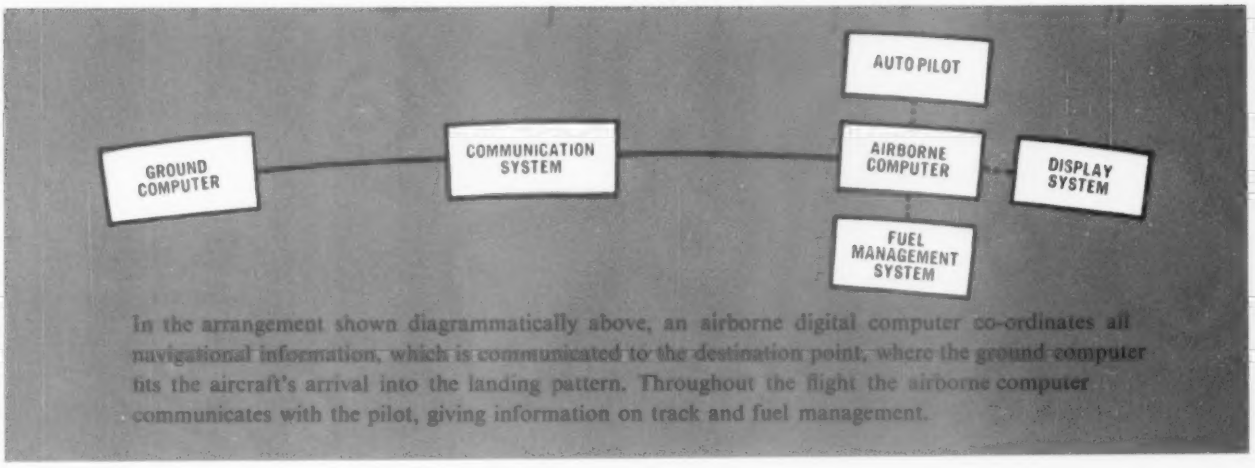

In the arrangement shown diagrammatically above, an airborne digital computer co-ordinates all navigational information, which is communicated to the destination point, where the ground computer fits the aircraft's arrival into the landing pattern. Throughout the flight the airborne computer communicates with the pilot, giving information on track and fuel management.

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FARNBOROUGH '61

Shaping up to the Future

THIS year, in order to ensure that our readers get the quickest possible report on what there is to be seen at the twenty-second S.B.A.C. Show we have taken the decision to close our report on Monday night. Such are the vagaries of the British climate that in spite of this decision we might have had a splendidly sunny day on Monday in which to take photographs and see the flying. As it turned out the sun did not break through the hyper-humidity and there were times when Major Oliver Stewart, the doyen of air commentators, had an empty sky to talk about.

On Monday the crowds were in the big marquee, around the outside stands and grouped two or three deep round the Royal Artillery parade ground at the end of the runway. Here they were treated to a first-class display by the Army and the men of the Royal Artillery (No. 37 G.W.) Regiment. Missiles were prominent on the runway and on the hill.

There were crowds, too, round the exhibit of the lone-wolf firm Handley Page Ltd. Their H.P. 115 was regarded by many as the shape of things to come and there were knowledgeable people to indicate exactly where Rolls-Royce VTOL engines could be placed to turn this model of a supersonic airliner into a VTOL version of the real thing. Once again the Short SC 1, the VTOL aeroplane that has everything, demonstrated the strangeness of the British. They have the answer, but will not press on with it.

Handley Page have their feet firmly on the ground of practical day to day aviation as well and were able to report the decision to put down another twenty-five Heralds on the production line. The Herald on show at Farnborough is the version with longer fuselage and for increased gross weight to 43,000 lb. as reported elsewhere.

Visitors to Farnborough on Monday were enthusiastic in their praise for the BEAGLE exhibits. The sleek lines of the new British contenders for the international light plane market were widely admired. Some genius had challenged the aircraft finish manufacturers to produce that brand-new-minted penny look. This shining copper finish with white paint and the smart Beagle insigne created a deep impression. These light aeroplanes with the airline accommodation and instrumentation raised morale in a big way. The value as sales appeal of the RR trade mark on the engine panels must be terrific.

British interest in space flight is emphasized by the gleaming gold satellite on the Hawker-Siddeley Aviation stand. This reminder of what communications satellite business could mean to their country was not far from the Fairey-Ferranti exhibit, a reminder of the contribution to automation made by this former aircraft constructor.

One great topic of conversation over the luncheon tables had to do with the frequency of the Show. Should it continue to be shown yearly, or has the time at last come to make it international and alternate with the Paris Show. We would think it difficult to assess the exact balance of opinion on this particular aspect.

Signs are not lacking that there are exhibitors who have satisfied themselves that the effort involved in producing exhibits for the static show has proved too costly. In one case a figure of 4,000 productive man/hours was quoted by one well-known accessory manufacturer.

Whatever the arguments there is no doubt that the S.B.A.C. Show has grown into part of the national rhythm of existence. An important aspect is the opportunity the Show provides for old professional friends to get together and exchange aviation gossip,

whether current in this country, across the Continent or over the United States. Nevertheless, the institution of the S.B.A.C. Air Show is not solely for the purpose of providing a garden party. Basically, the conception is to sell aeroplanes.

One of the problems of doing this at an Air Show in England has to do with the climate. For instance, at Farnborough on Monday at 15.45 hours the cloud base was 300 ft., visibility ¼-mile and a "clamp" extended over the whole of Southern England. In consequence 38 Group had to cancel their assault on the Tower, the Hunter FGA.9s could not take off from Stradishall. The Beverleys could not get into Abingdon to pick up their parachutists.

Two formations of Sea Vixens appeared in the murk; so that the Navy did manage to get through. They brought along some Gannets too.

This unpredictability of the British weather raises the question of the best time for an Air Show. The old Hendon Air Displays, held in mid-summer, seem always (at least in retrospect) to have been held in the sunshine. It is broadly true to say that the weather in mid-June over the years is conspicuously better than it is around August Bank Holiday.

Recollections of wet days at Farnborough make one wonder whether it would not be better to hold the Show in June. This, of course, might come about if the Show were arranged to alternate with the Paris International Air Show which is held in June and seems to enjoy fine weather for its main flying display.

There are those who argue that the main importance of the Farnborough Show lies in the exhibits in the three hundred static displays. And for the display and examination of these exhibits fine weather is not essential. Hence, no doubt, the query as to whether the exhibition of these could not take place in London itself.

Today, aviation business has reached the stage where instrumentation in the aircraft is playing a major part. It is playing a major part in the operation of the aircraft, it requires a major part in productive man/hours and in financial expenditure. Thinking along these lines it is not hard to reach a conclusion that the exhibits must more and more appeal to specialists and in many cases to small groups of specialists. To such specialists the flying display can but seldom demonstrate the features that are of most interest; in this connection one thinks of the inertial guidance of rockets or of the forthcoming autoland capability of the D.H. Trident.

But such discussion will not affect next year's Show. 1962 is already being tipped as a vintage year. So many brand-new aeroplanes can be seen in the offing.

IN THE AIR—

The Services Take Over

FROM its original function as a measure of technical progress among the civil and military aircraft produced by the British industry, the annual S.B.A.C. flying display has evolved into a Hendon-type spectacle in which all three Services vie with each other to produce a programme whose principal function appears to be to entertain.

This change in emphasis undoubtedly broadens the appeal of the S.B.A.C. flying programme. If it is less successful in fulfilling its avowed purpose as a practical airborne commentary on the function of the many accessories on display in the static exhibition, this must

Above: Beagle's spritely twin with John Nicholson in the driver's seat. *Left:* Four of the eight Skeeters which make up the Army Air Corp's helicopter drill team. *Below:* The Royal Artillery's Thunderbird and Blue Water demonstration area viewed from the air.

Strong man act by the Wessex as it pulls a 50-ton load down the runway.

Photographs copyright "The Aeroplane and Astronautics"

Quick lift-off by the Gyron Junior Javelin.

be attributed to the stagnation imposed on the development of new military aircraft by the disastrous Defence White Paper of 1957.

Tushino, a few weeks ago, with its shattering revelations of Russian military progress since approximately the same time, showed the sort of developments we should now be seeing at Farnborough. Having successfully misled Western politicians on their military aviation policy, the Russians have left us with a development gap which has been made painfully obvious by the total lack of Service prototypes or new designs at Farnborough, 1961.

No amount of formation aerobatics or simulated atomic strikes with mushroom smoke clouds can disguise this deficiency. And until the industry can press to achievement a high-priority plan to rectify it, such flying programmes as the present one are best regarded as reminders of its existence.

On the brighter side, ignoring the gloomy opening weather, Farnborough 1961 will be remembered as marking a long-overdue resurgence of interest in the field of general aviation. If it can be called a Beagle year—and there are two Airedales, the splendid B.206 and the stimulating Mark Eleven to justify that appellation—then nobody will grudge Peter Masefield's energetic team the public recognition of less than twelve months' truly formidable labour. At the time of last year's S.B.A.C. Show, the Beagle organization did not exist, and yet apart from the futuristic shape of the Handley Page 115, all the new ideas in the current display originate from Rearsby or Shoreham.

John Nicholson's supremely confident flying in the Beagle-bronze and white B.206X prototype reflects his considered contention that it is the nicest aircraft of the large number that he has flown, and if his upward rolls are less apparent than in more private demonstrations, this is only because the limitations of a Special Category C. of A. awarded after nine hours in the air must be publicly respected.

He is ably backed by the incomparable Ranald Porteous, whose near-aerobatics in the Mark Eleven are a memorable reminder of its power margin from the 260 b.h.p. R-R/Continental. Trevor Howard is also showing publicly for the first time the re-engined Airedale prototype, G-ARKE, whose deep-chested cowling covers another product of joint Rolls-Royce/Continental endeavour. Pee-Wee Judge, last but not least of the Beagle demonstrators, manages to produce a remarkably quiet new whine from the rejuvenated bottle of the Auster 6/Terrier.

Unless the Hawker P.1127 flies past sometime during the week, which is a possibility, although without transitioning, the prize for technical novelty must go to the paper-dart delta H.P.115. Perched in his ejection-seat-equipped pod, Sqn. Ldr. Henderson must by now have an intimate knowledge of most of the surface of Farnborough's 3,000 yd. main runway, which the slim delta, replying on its vortex-generated lift because of its aerodynamically-stalled wing, uses to become airborne. Under Viper-urge, the climb-away is flat, and the gentle manoeuvring is an indication of the early stage of flight-testing reached by this very interesting low-speed research project.

In his steep turns over the airfield, Sqn. Ldr. Henderson reveals the stark 74° swept-delta planform of his thick wings, which have fabric-covered control surfaces at their extremities, with inset metal tabs. The leading edges, of wooden form, are sharply tapered to a knife edge, and are interchangeable for development trials. The rudder is half fabric-covered and half-metal, and also appears to be non-power operated.

The remaining aircraft in the flying programme—few of which flew on Monday's opening day—are of more familiar contours, and all have previously appeared. One of the few modifications to be shown for the first time, was the midnight-blue Javelin test-bed for the D.H. Gyron-Junior turbojets, with a few new lumps and bumps on its original Mk.1 airframe. The slipper-tanked Gnat Trainers, with a longer nose for the production type, present slightly different contours, and a change in colour-scheme to operational atomic white is presented this year by the Buccaneer.

In the absence of the P.1127, the bulbous Short S.C.1 continues to serve as a reminder of British technical supremacy in the field of jet VTOL, as well as of the need for a follow-up in development if this lead is to be maintained.

A different sort of VTOL capability is being demonstrated daily, regardless of weather, by Martin-Baker, with their zero-height, zero-speed ejection seat. One-fifth of a second rocket boost sends dummy and seat up to about 350 ft. for a remarkably clean separation, following the flash of drogue-gun firing, and the streaming out of duplex drogues and parachute.

Eclipsing the quintuple R.B.108 noise and fury of the SC.1 is the after-burning take-off thunder of the 18 Avons of No. 74 Squadron's Lightnings, before their immaculate formation fly-past and rolls. There is little let-up in the decibel scale throughout the entire half-hour display by the R.A.F., except for the blessed silence

Focus of attention in the aircraft park on Monday were the H.P.115 and the Beagle B.206.

About the Show . . .

of the P.T.S. instructors in free-fall after their backward arm-linked march from the rear of a Beverley at 9,000 ft.

Otherwise, the air is split by the scream of No. 54 Sqn's eight Hunter 9s beating up the control tower, the busy whirr of 225 Sqn's Whirlwind helicopters delivering their troops to the scene of battle, a buzz of Belvederes as two disgorge their troops, and the throatier roar of the four troop-landing Beverleys.

From their capacious maws spill forth Land-Rovers, a 105 mm. recoilless rifle, Ferret scout cars, and in the case of two of them, 92 troops each. These are backed up by the supply dropping of Pioneers and Twin Pioneers from No. 230 Sqn, and by the return of the Whirlwinds and Belvederes as flying cranes, with more Land-Rovers and 105 mm. guns. In all, about 52,000 lb. of equipment and some 350 personnel are lifted in the battle of Farnborough, which gives a fascinating illustration of the tactical duties of No. 38 Group.

On Monday, a very low cloud base and thick mist prohibited the contrail flights of 40 aircraft from Bomber Command, including 12 Vulcan B.1s and 2s, eight Victors, 10 Valiants and 10 Canberras, and in fact prevented the presentation of the entire R.A.F. programme. This should have included formation aerobatics by the Blue Diamonds of No. 92 Sqn, whose 16 Hunter 6s are operating from Dunsfold for the S.B.A.C. Show, and the well-known Jet Provost team of synchronized aerobaticists from C.F.S., which is based at Farnborough.

Honours undoubtedly went to the Royal Navy on Monday, as well as to the exciting "cross-over" pattern flying from the N.C.O. pilots of the Army Air Corps in two boxes of four Skeeter helicopters. The Navy completed a large part of its flying, including operations from H.M.S. "Hermes" by Sea Vixens and Gannets. A Scimitar completed a photo-recce run over the airfield, and also made the first public demonstration in this country of a runway-arrested landing.

As the mainstay of the Royal Navy's show, the 10 Scimitars of No. 800 Sqn. are based at Farnborough for their stimulating demonstrations of formation flight-refuelling, demonstrated by the buddy-packed Sea Vixens of No. 899 Sqn., Yeovilton, which managed to cope with the weather for their appearance on Monday.

H.M.S. "Hermes", at sea in the Channel, is the base for a Scimitar and a Sea Vixen from 804 and 890 Sqns., respectively, and these are employed in demonstrating a typical LABS manoeuvre, complete with ground effects, for launching a nuclear weapon. "Hermes" finally provides, if all goes well, 10 Sea Vixens and five Scimitars, plus 4 Gannet A.E.W.3s from 849C Flight, for the closing fly-past.

No account of this year's Farnborough flying, however brief, would be complete without mention of the Westland circus, which once again has managed to find some novelty to exploit. This primarily takes the form of a demonstration of heavy load-towing by a production-type Wessex, flown by "Slim" Sear, with the aid of the full automatic control and stability equipment fitted to this anti-submarine rotorcraft.

The built-in Doppler and radar altimeter equipment are used to maintain the correct trail angle for the tow-rope of the heavy vehicle transporters, with Ferret armoured car, Westland-Scout helicopter and R.M. Citroen light van (previously air-loaded by the Gnome-Whirlwind) on board. The Wessex eventually accelerates this load of nearly 50 tons to a speed approaching 20 m.p.h. along the runway, while an equally spectacular note is struck by the Hosegood/Wilson-flown Belvedere spitting machine-gun fire from its embarked 30 troops before these are rope-dropped on to the airfield.

The Wessex also demonstrates its auto-hover capability, with dipping sonar lowered, and has the additional facility of being controlled, in the flying crane role, by a lead from the ground.

Developments in Electronics

SPECIALISTS will no doubt find many less immediately obvious trends in electronic progress at Farnborough this year, but, for the non-specialist, there appeared to be two principal new developments.

One is related to the effort being made to bring the reliability of continuously used electronic equipment as near as possible to a 100% standard. The other—influenced, no doubt, by the reviving interest in private and executive aircraft—is the appearance of several new items of radio and navaid equipment designed for the operator of smaller aeroplanes.

Less specifically new developments to be seen are those concerned with the step-by-step improvement of air traffic control methods and with the programmes leading from auto-approach to auto-flare and auto-land with the next generation of transport aircraft.

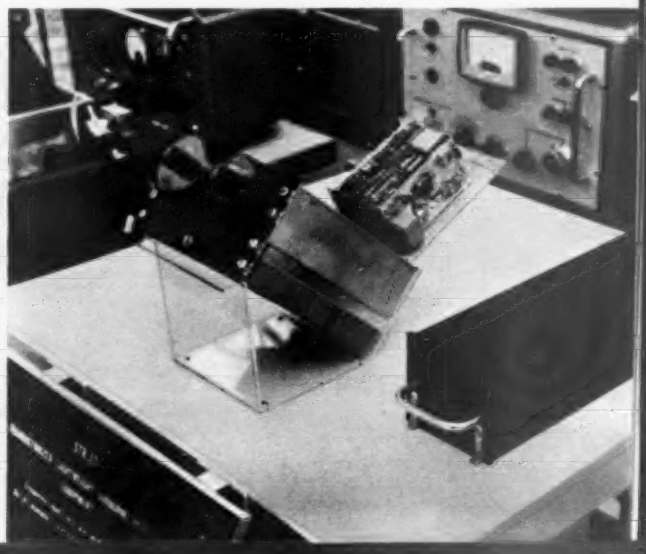
Below: a section of the display by Elliott Brothers demonstrating the uses to which a general-purpose Elliott 803 digital computer can be programmed to complete a wide range of functions to meet A.T.C. and other civil aviation requirements. (*Below, right*) one of the examples of radio for the executive operator—the Standard STR-37 lightweight, low-consumption VHF communication equipment.

A new approach to the problem of ensuring the reliability of transistorized data-handling and radar display systems is demonstrated by DECCA RADAR. This involves the detailed application of environment stabilization engineering, in which components and circuits are held at a constant internal temperature to within a quarter of a degree Centigrade. Started as a private venture, the project now has Ministry support.

During trials covering a period of more than 10,000 hours (representing well over a year of 24-hours-a-day operation) an availability rate of better than 99.75% has been achieved with outside conditions varying between 0°C and 45°C in temperature, and 10% to 90% in humidity, and with the mains voltage fluctuating by ± 15%. A total close-down period of only about 22 hours was necessary, for the changing of two components, during the year's trials.

At Farnborough the technique—which involves an integral liquid refrigeration unit and heater system—is demonstrated as applied to Decca's new TDS Mk.V. This consists of central display "drive" equipment with associated transistorized viewing units.

The "drive" equipment displayed is in electronic cabinets which operate in conjunction with duplicate liquid cooling units and an associated heat exchanger. The cabinets contain the printed circuit and transistor boards, which are housed in open cold plates



surrounded by heater blankets to maintain temperature stability.

Such complete methods of environmental control are neither possible nor so necessary in the case of airborne equipment—in which the introduction of transistors has improved overall reliability, but has introduced new problems in designing equipment to make the best use of these solid-state devices. With transistors there is no serious heat-dissipation problem and entire circuits can be isolated from their outside environment. In the MARCONI "Sixty Series" equipment, for instance, circuit sections are sealed in a dry inert gas to protect them from atmospheric changes.

For Private Aircraft

The market for radio aids suitable for smaller private aircraft is a comparatively small, but obviously growing one on this side of the Atlantic, and there are several signs of developing interest. STANDARD TELEPHONES show a lightweight, low-consumption VHF communications set (the STR-37) which is fully approved and suitable either for executive aircraft use or as standby airline equipment.

ELLIOTT BROTHERS show similar equipment based on a French design; this will be available in production form next year. SMITHS are showing the Motorola equipment as part of the mock-up of the instrument panel for the Beagle 206. EKCO are showing new lightweight (45 lb.) weather radar equipment, with a smaller scanner, suitable for executive aircraft.

There appear to be two broad requirements for private aircraft radio—one for local and non-airway use, which need not be approved and may be low in first cost, and another, for use in controlled zones and airways, which must be fully approved Class I equipment and which necessarily has a fairly high first cost in private-owner terms.

Full-scale working exhibits leading towards A.T.C. improvement and automation are to be found in two of the outside displays. Equally important non-working exhibits in this field are those of Marconi and Cossor.

The active radar park demonstrations are those of the M. o. A's Air Traffic Control Experimental Unit and of ELLIOTT BROTHERS.

Demonstration of environment stabilisation of radar and data-handling equipment by Decca Radar. In the lower of the two main cabinets is the power and cooling equipment for the maintenance of stable conditions in the electronics cabinet above.

The A.T.C.E.U. demonstration shows the way in which air traffic control problems are simulated. The special demonstration by Elliott Brothers shows how a standard general-purpose 803 digital computor can be programmed to complete a wide range of functions; in the A.T.C. field these functions cover traffic control procedures, including the filing of flight plans and the simulation of aircraft movement with a PPI display. Also shown is a VERDAN airborne digital computor which has approximately the same work capacity as the 803 yet which occupies less than 1½ cu. ft. and weighs only 82 lb.

In the indoor display MARCONI are showing an example of their radar display unit (SD 1015) which is probably the first production unit capable of displaying raw and synthetically produced information on one 12-in. PPI tube. Despite its physical compactness it incorporates character-reading facilities. Nearby is the tabular display unit (SD 1016) which forms a section of the complete tabular display equipment which is designed for use in data processing systems whether the information is derived from a digital computor or processor.

An active exhibit on the Marconi stand, and seen for the first time, demonstrates the operation of an experimental solid state diode parametric amplifier and mixer which gives clearer echoes at much longer ranges. In the Farnborough demonstration (working from recordings) the responses are effectively compared with the same echoes from a low-noise triode.

The future of radar as an actively controlling rather than as a monitoring medium for air traffic control depends on the development and use of secondary surveillance radar. COSSOR are showing components of their civil system which, in June, successfully completed acceptance tests by the M. o. A. at Heathrow.

The new Marconi unit (*left*) with a 12-in. tube on which raw radar and synthetic displays can be combined. On the right is the tabular display equipment.

A corner of the Ministry of Aviation's demonstration of the work of the Air Traffic Control Experimental Unit on the outside radar site.

About the Show . . .

New in the Static Show

COMPONENTS, ground equipment and services for executive aircraft and the smaller airline operator are prominent among the new exhibits on display.

SHELL-MEX AND B.P. are featuring new aviation fuel dispensing equipment designed to met the needs of private and executive aircraft, including helicopters. The first of these units, comprising a pump complete with reel, hose and electrically operated rewind mechanism, has been installed at Panshanger Aerodrome.

A chute-launched parachute flare for light aircraft suitable for emergency landing and search and rescue purposes is shown by SCHERMULY PISTOL ROCKET APPARATUS. The chute of this unit measures approximately 2½ in. x 16 in. and the flare, of over 200,000 candle power and 80 seconds' duration, is stated to provide good wide-area ground illumination from a height of 2,000 ft.

H.M.L. ENGINEERING are devoting their stand almost entirely to the requirements of the smaller airline. Among the company's exhibits are two modified versions of their Mark V mobile test rig for inter-flight servicing work which enables all hydraulic controls and components to be tested without running the aircraft's engines. An 8-g.p.m. hydraulic component test bench, similar to the company's universal component test bench, incorporating double-acting hydraulic facilities, a hydrostatic test rig, and a variable DC voltage system is also featured.

Light aircraft components in the indoor exhibition include the LOCKHEED main and nose landing gear, complete with retraction system and flap actuators, for the new Beagle 206. The Lockheed hydraulic power pack for this aircraft consists of an electric motor-driven miniature pump with self-contained fluid reservoir, accumulator, command switch and selector valve.

Radio aids and instrumentation for executive types are featured by a number of exhibitors. STANDARD TELEPHONES are displaying their new STR-37 fully transistorised VHF transmitter/receiver which has 400 switched channels at 50 kc/s spacing in the 116 to 135.95 Mc/s range. Self-contained, this unit has a matching radio navigation system made up of three units providing ILS/VOR/marker facilities and instrument drive.

On the SMITHS AVIATION DIVISION stand there is an instrument panel mock-up for the first Beagle B.206 prototype containing more than 30 flight, engine, navigation, fuel and airframe instruments.

Ancillary equipment for the Argosy, VC10, Belfast and Trident is prominent on many stands. BRITISH OXYGEN have the Argosy LOX system test rig as the centrepiece of their display to demonstrate the company's new 25-litre liquid oxygen packaged units now in production for this aircraft and Transport Command Comets. A twin container version of the system is also on order for the Belfast.

The Trident is featured by SPERRY, who have a model flight deck to draw attention to the 12 or so functional instruments which they are producing for this aircraft. VC10 installations on the NORMALAIR stand comprise an electro-pneumatically actuated pressure control system, duplicated vapour cycle cooling packs and liquid oxygen equipment. A number of SEP.5 multiplex autopilot components for the Trident and the Belfast are highlighted in a flight control system display on the Smiths Aviation Division stand.

A new 30 kVA constant frequency generation system employing a Sundstrand constant-speed drive and components similar to those already proven on B.O.A.C. 707s is shown by the ENGLISH ELECTRIC Aircraft Equipment Division. A single channel—consisting of a 38-h.p. drive with an output speed of 8,000 r.p.m., a 30 kVA brushless generator, combined static control and protection unit, and a three phase contactor—weighs 179 lb.

Amongst the ROTAX exhibits there is a new range of 400-c.p.s. static inverters designed specifically to replace rotary inverters and their associated control panel. Other new units for use with Rotax generation equipment include a static voltage regulator and control, and protection units.

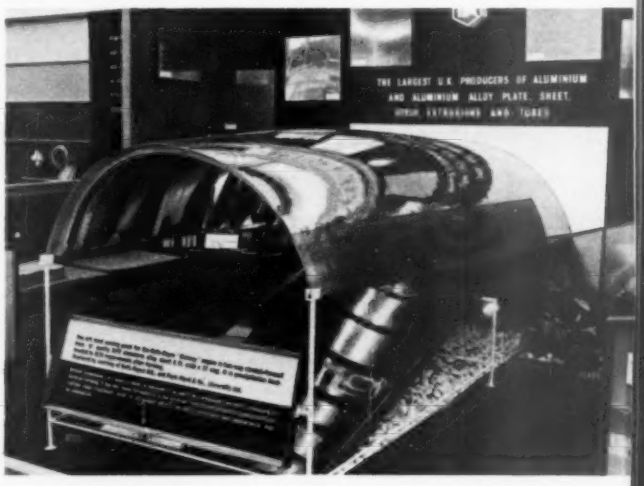
PLESSEY are exhibiting a 40-kVA generation system similar to that being installed in the VC10 and proposed for the B.A.C. One-Eleven. This brushless generator system features transistorized control equipment employing printed-circuit sub-unit techniques.

G.E.C. are displaying their new system for controlled aircraft cockpit and instrument lighting in which the intensity of illumination is continuously varied by a circuit using transistors and silicon-controlled rectifiers.

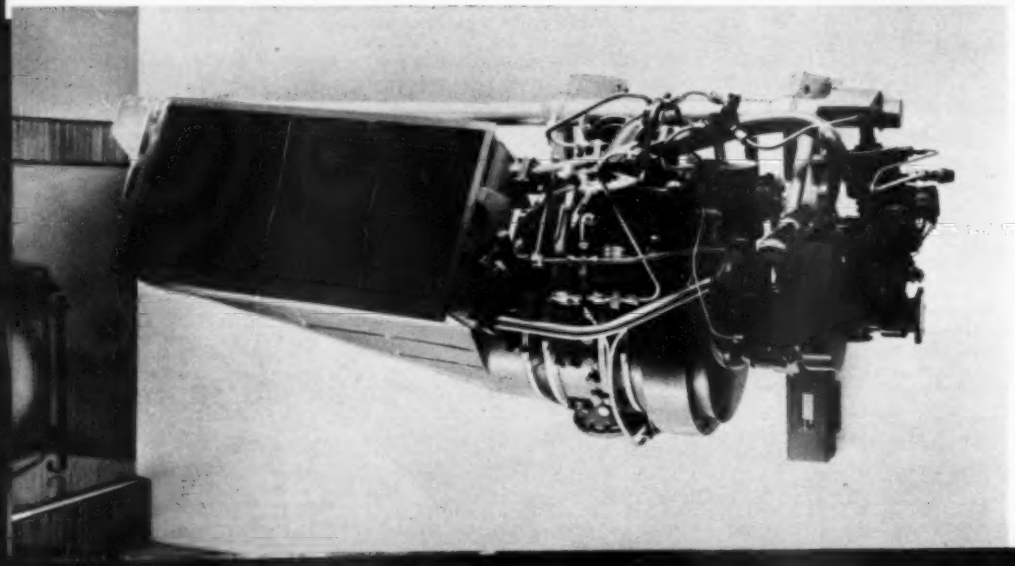
The new FERRANTI Type 100 intermediate-size stable platform for airborne navigation systems is also on display. Fully manoeuvrable, it carries three accelerometers and is stabilized by three flotation type gyros, to provide short-term inertial navigation facilities.

New plant and technical development employed in the production of basic aircraft materials are featured in a number of exhibits.

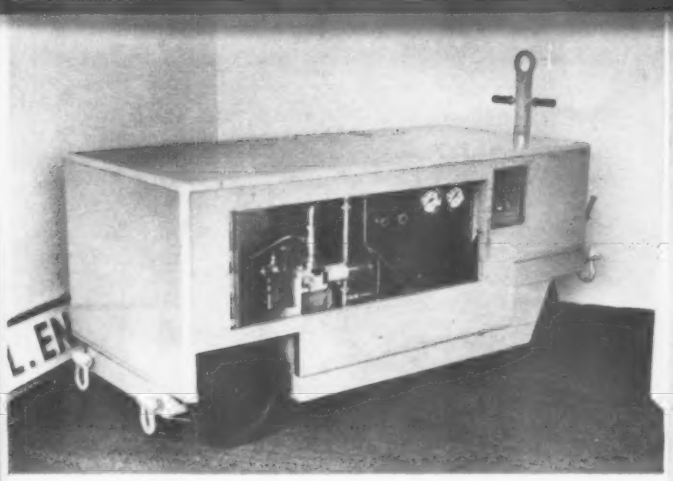
BRITISH ALUMINIUM's principal item is a left-hand side panel for the cowling of the Rolls-Royce Conway stretch-formed from 6 ft. wide 21 s.w.g. 2L72 sheet. A compound contour fabrication, it demonstrates the use to which the company's recently introduced



British Aluminium are exhibiting this left-hand cowling panel for the Rolls-Royce Conway to illustrate the use of their new quality 2L72 sheet for stretch forming applications.



Amongst equipment for the VC10 on the Normalair stand is this vapour cycle cooling pack. The basic component is a single-stage centrifugal compressor driven by an air turbine.



A new modified version of the H.M.L. Engineering Mk. 7 mobile test rig for inter-flight aircraft servicing work.

new quality sheet for stretch-forming purposes is being put.

One of the pioneers of vacuum melting techniques, JESSOP-SAVILLE are showing how these methods have been applied to the production of a wide range of materials, including H.46 and H.53 for ferritic gas-turbine disc applications and austenitic-type alloys where high creep strength with high proof strength is required. The use of stress-relieved aluminium alloy plate for integral aircraft construction is demonstrated on the ALCAN INDUSTRIES stand by a section of a Blackburn Buccaneer wing assembly built on this principle.

Military developments on show for the first time include the M.L. AVIATION assisted-evacuation crew seat. Designed to assist a crew member of an aircraft to leave his seat whilst he is fully equipped and subjected to *g*-forces, this unit has an inflatable seat-cushion operated by a 1,200-p.s.i. bottle, a tapered back rest and a combined parachute pack containing chute, personal survival gear and emergency oxygen bottle in a single envelope.

DUNLOP are featuring the emergency aircraft runway arrester system designed and developed by the R.A.E. Naval Air Department at Bedford in collaboration with the company's aviation division. Illustrated by photographs and diagrams, the system comprises a cable, stretched across the runway, attached at either end to a nylon webbing band wound round a horizontally-mounted drum of an energy-absorbing installation incorporating a Dunlop multi-disc friction brake.

Standard Telephones are exhibiting this new wide aperture radio direction finder based on the Doppler principle. It is intended for civil aviation use on secondary airfields.

New techniques in the ground radar field can be seen on both the Decca Radar and Marconi stands.

DECCA are featuring a fully transistorized radar display and data handling system which provides a new level of reliability through the application of environment stabilisation. This technique uses an integral liquid cooling system to maintain all circuits at a constant temperature.

MARCONI exhibits include a tabular display unit which receives digital information from a computer and converts this directly into characters on the face of a cathode-ray tube.

Rockets and Missiles on View

BLUE STREAK, towering high over the Missile Park, 80 ft. tall and 10 ft. in diameter, serves as a signpost on the hill in front of the Exhibition Hall. It emphasises the importance of the Western German agreement to join the European Space-Launcher Organisation.

The DE HAVILLAND Blue Streak exhibit though not representing "launchable hardware"—being a factory mock-up used for determining pipe-runs and solving installational problems generally—nevertheless gives a realistic idea of the project. A mirror, inclined beneath the propulsion bay, shows features of the engine installation, including the combustion-chamber actuators and "black box" equipment. The combustion chambers are shown in mock-up form, but nearby a Rolls-Royce RZ.2 Mk. II engine is available for inspection.

The actual booster will have two Rolls-Royce engines producing a combined thrust of 300,000 lb., and gimbal-mounted to control the vehicle in pitch, yaw and roll. Immediately above the propulsion bay are tanks with separate storage for 26 tons of kerosene and 60 tons of liquid oxygen.

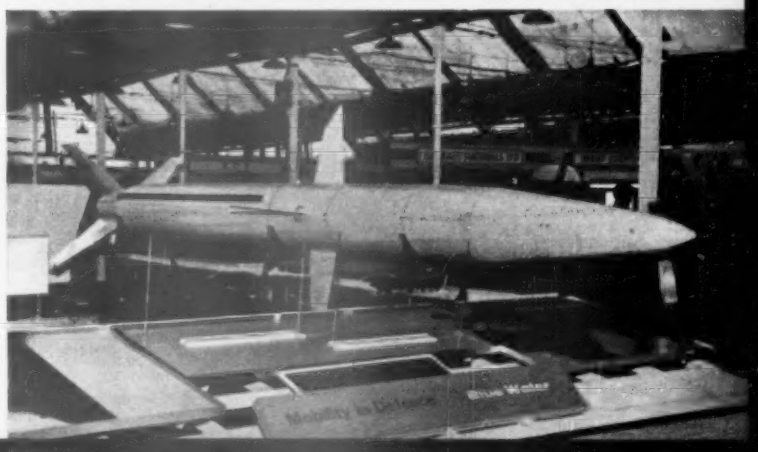
When originally conceived as a ballistic missile, the vehicle was to have a warhead separated from the tanks by a bay housing the inertial guidance equipment. This section is now replaced by a separation bay to which it is proposed to attach the French second stage of the satellite launcher; this is shown on the Blue Streak exhibit. In practice, it would be provided with spring-loaded doors serving as vents for second-stage efflux at separation.

Two models of the complete three-stage launcher are to be found in the Exhibition Hall, one by the MINISTRY OF AVIATION and the other by HAWKER SIDDELEY. These depict the Blue Streak with a French second-stage, and a third stage based on a design by the R.A.E. in order to obtain realistic performance assessments. The actual configuration of the top stage will depend on decisions reached at a further meeting of the projected European Space Launcher Organisation—probably in London next month—with Germany and other European nations represented.

Elsewhere in this issue (p. 321) will be found a cutaway drawing of the Blue Streak complete with upper staging. According to provisional calculations made at the R.A.E., the vehicle could place a satellite of 2,200 lb. in a polar orbit at 300 miles or 500 lb. at 5,000 miles. Corresponding payloads for elliptical polar orbits, with perigee heights of 300 miles and apogee heights of 7,000 and 100,000 miles, are respectively 940 lb. and 320 lb.

By using liquid hydrogen and liquid oxygen in the top stage instead of kerosene/LOX, payloads of 3,400 lb. and 1,400 lb. would be attainable for the 300 and 5,000-mile circular polar orbits.

Two examples of payloads for the three-stage launcher are illustrated on the MINISTRY OF AVIATION stand. One depicts a design for a communication satellite, providing hundreds of telephone channels as well as TV relays. It comprises a cylindrical centre-body with cruciform blades containing solar cells in order to power



The English Electric Blue Water SSM as it appears on the British Aircraft Corporation stand.

instrumentation and trans-receiver equipment in end pods. The complete satellite would be sprung open when it arrives in orbit.

The second picture shows a model of a 1,500-lb. astronomical satellite which would embody a 16-in. UV-telescope for examination of stellar characteristics. The spectrum details would be relayed to the ground. A polar orbit at an altitude of more than 300 miles is envisaged for this application with 5,000-mile orbits for communications purposes.

BRISTOL SIDDELEY are showing for the first time the later mark of Gamma rocket engine which has been under development for the Black Knight for some time. This is the Gamma Mk. 301, which supersedes the original four-chamber Gamma Mk. 201 having a sea-level thrust of about 16,000 lb.

The new propulsion unit shows considerable change, including simplification of the control system, affecting the trunnion mountings for the swivelling combustion chambers, and new combustion chambers which profit from experience gained with Stentor. These latter may be presumed to have a sea-level thrust of about 6,000 lb., or some 24,000 lb. for the total unit.

In the original R.A.E. study proposals for an all-British Blue Streak satellite launcher, the Gamma Mk. 301 engine was to have propelled an enlarged diameter (4 ft. 6 in.) version of Black Knight as the second stage.

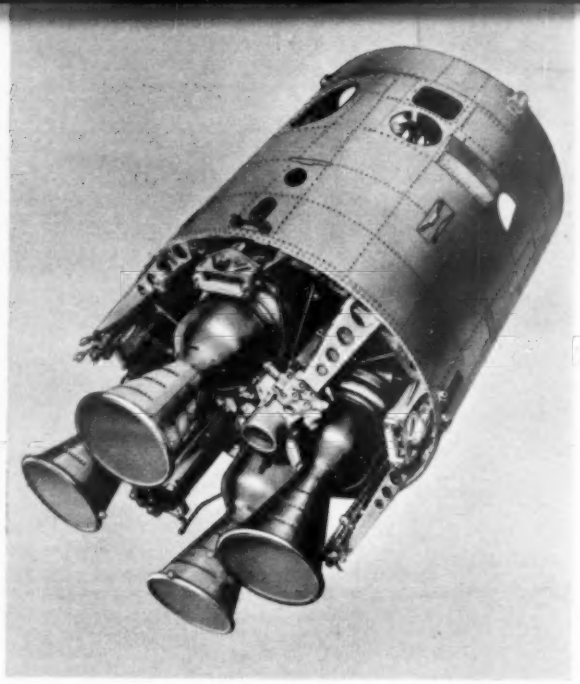
Another new rocket engine from Bristol Siddeley is the tiny RP37 boost unit, which has a (controllable) thrust up to 170 lb. Running on kerosene and hydrogen peroxide, it will boost the ceiling of the Jindivik target drone to 65,000 ft.

DE HAVILLAND are exhibiting their latest rocket development, Spartan I, a packaged liquid propellent engine. This is described as one of a series of rocket units which combine the more important advantages of both liquid and solid propellents. It has been developed under a licence agreement with the Thiokol Chemical Corporation.

Nitric acid serves as oxidant with an amine fuel, the propellents being force-fed into a long cylindrical combustion chamber by pressure created by the burning of an I.C.I.-developed solid cartridge. The unit would appear to have a thrust of some 6,000 lb. if run for about five seconds.

Advantages claimed for the system over an equivalent "solid" are that it is much less sensitive to ambient temperature; if it is too cold, solid propellents tend to crack, and if too warm they melt. Also, whereas solid units will often crack when dropped, a liquid unit of this kind given the same treatment will usually suffer no internal damage.

Blue Water, the 25-ft. tactical missile of some 75-mile range, is also shown for the first time at Farnborough. The Royal Artillery put on a special tarmac display. On the stand of the BRITISH AIRCRAFT CORPORATION is a round which will be actually test-fired as part of the development programme. Telemetry equipment is installed in the warhead section and, for purposes of exhibition, a dummy rocket motor is fitted.



First picture of the "up-rated" Bristol Siddeley Gamma Mk. 301 rocket engine to be used in Black Knight. Designed for hypersonic research in the upper atmosphere, this three-stage Jaguar vehicle has been jointly developed by W.R.E. in Australia and the R.A.E.

This missile was developed to the same NATO specification as the American Sergeant SSM, as a replacement for the Corporal. Apart from the demonstrated effectiveness of the weapon itself, handling and launching have been reduced to the least possible number of operations.

The launcher-transporter carries the missile, while the ground computer, on a ¼-ton Land-Rover, feeds in all flight information. The circuits are "auto-checking," with considerable benefit to operator training, and there is no complicated pre-launch monitoring and sequence of operations. These features have won favourable comment even in America, and it seems no idle claim that "Blue Water has a response equal to that of a gun."

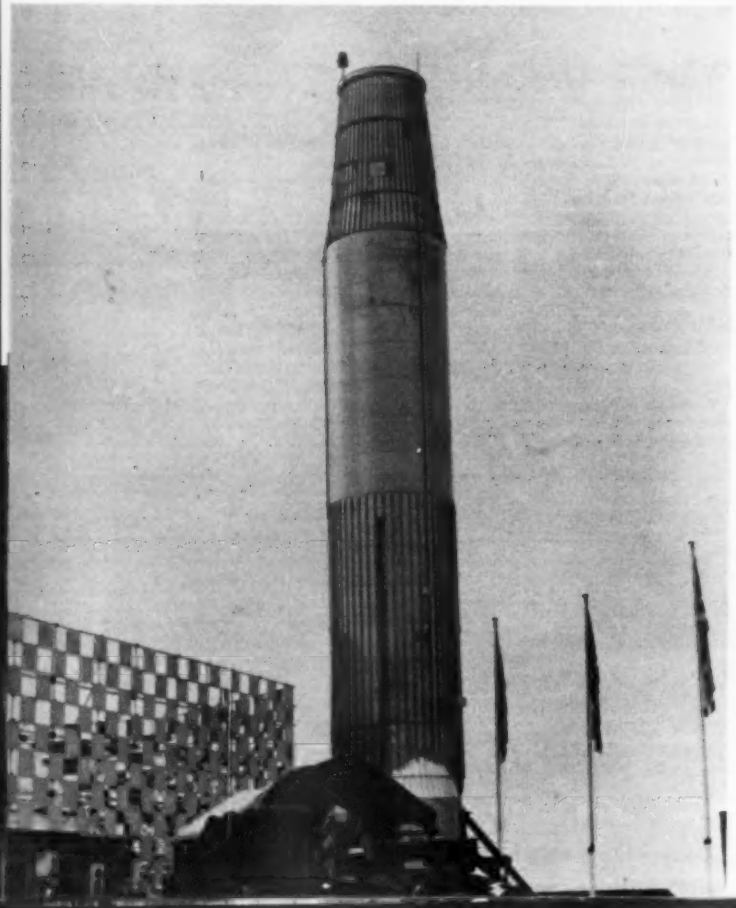
In the Missile Park, a joint exhibit by the WEAPONS RESEARCH ESTABLISHMENT, AUSTRALIAN MINISTRY OF SUPPLY, and R.A.E., Farnborough, shows the appearance of the three-stage Jaguar hypersonic research vehicle. Based on an R.P.E. Raven rocket engine as used in Skylark, the vehicle has upper stages developed in Australia by W.R.E. Its primary function is the investigation of basic aerodynamic problems at speeds up to two miles/sec. The first stage boosts the vehicle up to an altitude of about 80,000 ft. When a near-horizontal flight path has been attained, the second stage is fired by radio command from the ground; the third stage fires automatically upon burn-out of the second stage.

BRISTOL AEROJET are showing their 81-lb., 7.5-ft. long meteorological rocket which has been designed for the Meteorological Office to carry 10 lb. payloads up to 200,000 ft. Examples are now being test-fired with dummy payloads. The rocket's small dispersion should make it attractive for export to other countries which do not possess range facilities.

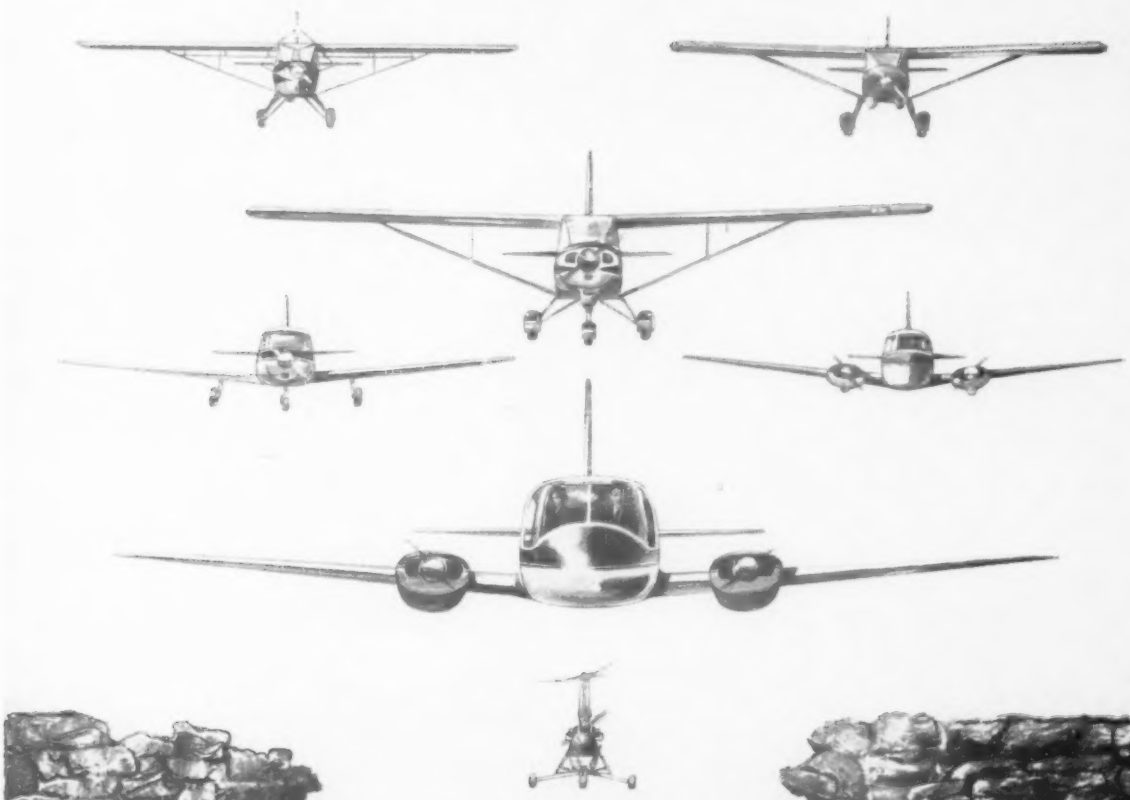
A high-speed launch system has been devised which consists basically of a 32-ft. long tube. This can be hinged to the chassis of an ordinary lorry and raised to the near-vertical firing position by means of a hydraulic strut.

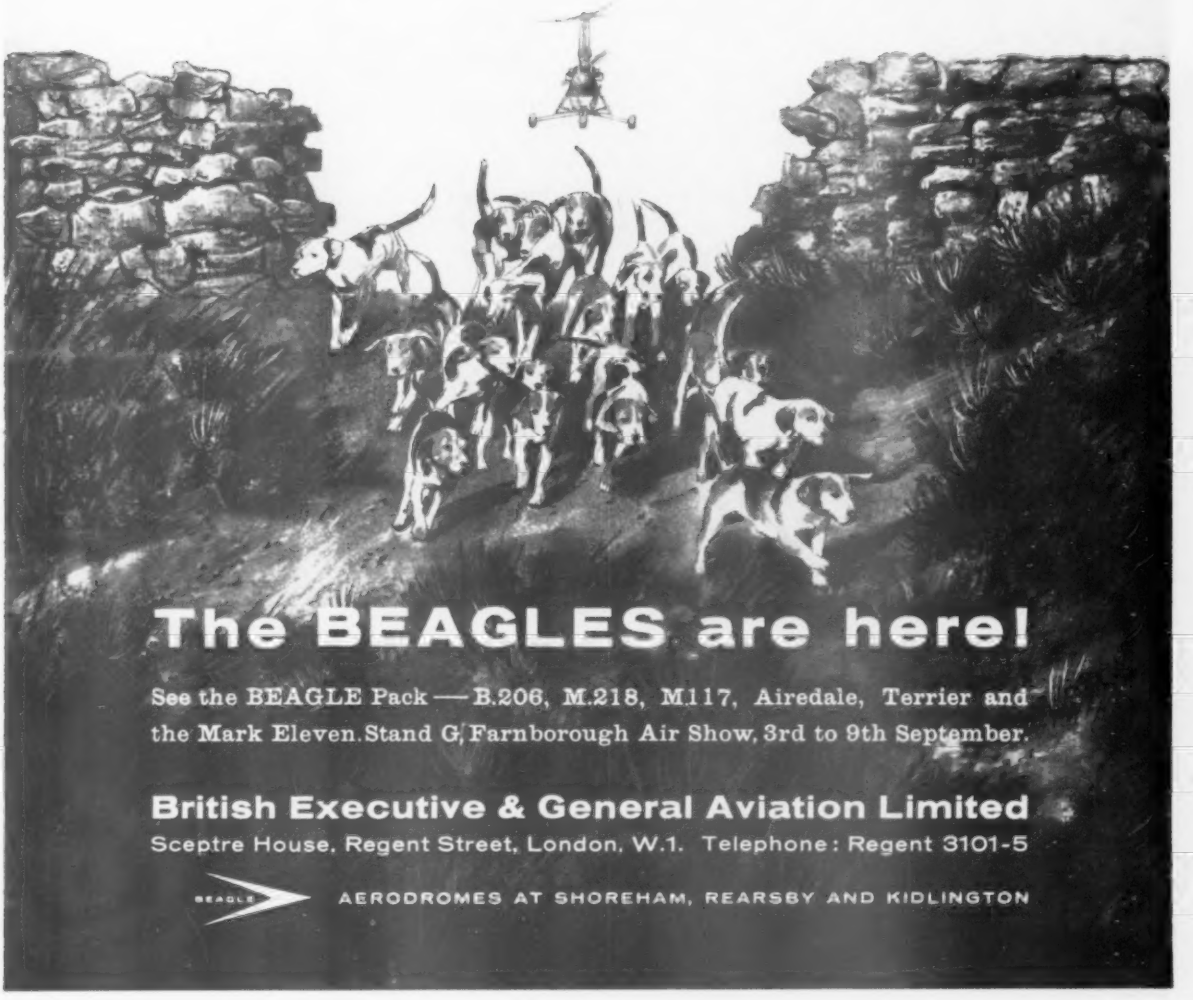
A small Irvin parachute pack is capable of lowering 5 lb. of instruments at a speed slow enough in the upper air to permit wind measurements to be made.

The manufacture of rocket motor cases by the wrap-welding of steel strip has been brought to a high art by BRISTOL AEROJET and one of their largest rocket motor cases can be examined on the R.P.E. stand in the Outside Equipment Exhibition. The motor has a diameter of 36 in. and produces a thrust of 40,000 lb. for 50 sec. According to R.P.E., "motors of this size are being used for the study of problems associated with the development of large motors for ballistic missiles or space applications at the Establishment."



The "mock-up" of the de Havilland Blue Streak towers above the Missile Park, necessitating a red light on top as a warning to aircraft.





The BEAGLES are here!

See the BEAGLE Pack — B.206, M.218, M.117, Airedale, Terrier and the Mark Eleven. Stand G, Farnborough Air Show, 3rd to 9th September.

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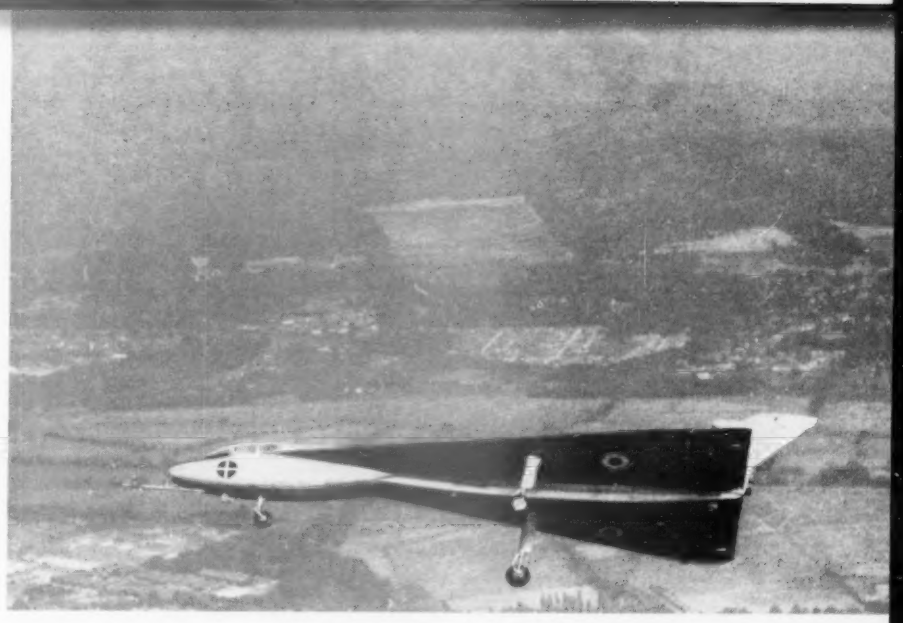
About the Show . . .

AIRCRAFT DISPLAYED

Notes on all the full-scale and model aircraft exhibits



DELTA DEBUT.—The Handley Page H.P. 115 research aircraft shows off the extremely narrow delta planform of its wing.

Armstrong Whitworth Argosy C.Mk.1 (four Rolls-Royce Dart RDa.8 Mk. 101). A production AW660, XN817, is participating in the flying display. This is the R.A.F. model with 2,680-e.h.p. Darts, nose radar and higher gross weight. The first AW660 flew on Mar. 6, 1960, and eight have now flown. The Hawker Siddeley indoor stand features the civil Argosy, and underlines the 12.2-hours-a-day utilization being achieved by the seven Riddle Argosy 101s. Details are available at Farnborough of the forthcoming Argosy 200 with a box-spar wing, to fly in 1963. Rolamat mechanized loading equipment, specified for the three B.E.A. Argosy 102s, is shown in the outside equipment park.

Auster AOP.9 (one Blackburn Bombardier 203). These standard Army Air Corps aircraft are used by the six Army parachutists for their display of precision jumping.

Avro Lincoln (four Rolls-Royce Merlin 68). The Napier test-bed for de-icing research with a Palouste generator in a ventral fairing and a Buccaneer test section mounted amidships.

Avro 698 Vulcan B.2. In the flying display is a Bristol Siddeley test-bed Vulcan, powered by two 17,000-lb.s.t. Olympus 201s and two 20,000-lb. Olympus 301s; it first flew with these engines on May 19, 1961. The first complete installation of four Olympus 301s in a Vulcan is now in hand by Avros. On the indoor stand, models show how the Vulcan will carry two Skybolts, on pylon fairings beneath each wing, or a single Blue Steel. A Vulcan is currently at Edwards A.F.B. for compatibility checks on the Skybolt installation.

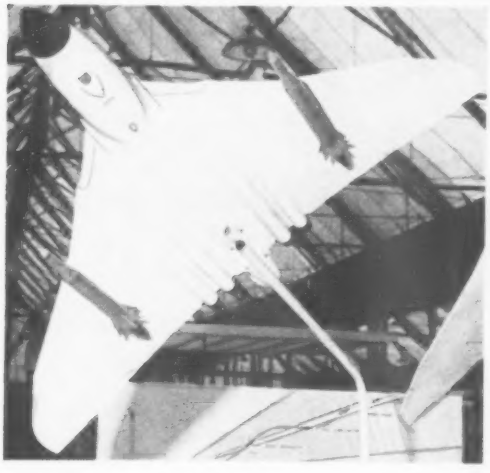
Vulcan 1s and 2s from Bomber Command squadrons are participating in the contrail fly-past over Farnborough each day.

Avro 748 (two Rolls-Royce Dart 514). The first production 748, G-ARMV is exhibited, having first flown on Aug. 30. It is in Skyways' colours and will start route proving trials later this year. Details are given of the range of 748 variants which now comprises the basic Series 1 (RDa.6 engines) and Series 2 (RDa.7 engines); the long-fuselage 748E with RDa7s, and a Super E with RDa.10s. Higher gross weights and increased payloads are announced, ranging from 10,586 lb. payload for the Series 1 to 14,000 lb. for the Super E. The Avro 748 first flew on Jne. 24, 1960 and made its first Farnborough appearance last year.

BAC One-Eleven (two Rolls-Royce Spey 515-14). A full-scale mock-up of a fuselage section of the One-Eleven is on the B.A.C. stand. The One-Eleven is new to Farnborough (last year, the smaller BAC-107 was featured). A "customer mock-up" has been built at Weybridge and an engineering mock-up at Luton and Hurn. Five aircraft are to be used in the flight test programme due to begin in the second quarter of 1963.

Beagle A.61 Terrier (one de Havilland Gipsy Major 10 Mk.1-1). This Beagle variant continues the work begun by Auster to convert ex-Army AOP.6s for glider-towing and club use—examples appeared at the last Farnborough as Auster 6As. The demonstration Terrier, G-ARRN, is furnished as a standard three-seater, with long exhaust pipe and silencer, soundproofed cabin, metal airscrew and spinner, and stall warning horn. Items available as extras include spats, strut fairings, blind-flying instruments, starter and generator. The standard price is £1,995.

The prototype Beagle-Auster Airedale is now powered by a Rolls-Royce Continental engine; the clean lines of the nose remain unaltered.



A model of the Avro Vulcan B.2 with pylon-mounted Skybolt missiles in place.

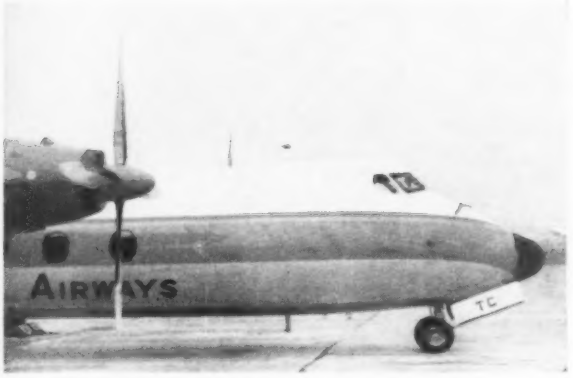
Photographs copyright "The Aeroplane and Astronautics"

Beagle A.109 Airedale (one Rolls-Royce Continental O-300). The first of four Airedales now flying—originally flown on Apr. 16 this year—G-ARKE has been re-engined by Marshall's with a 175-b.h.p. Continental O-300. The first flight with this engine was on Aug. 18 at Cambridge. Details are given on the Auster stand of the Lycoming Airedale, an example of which, G-ARNP, is in the static park, and the fuselage of G-ARNS is on the stand.

Beagle AOP.11 (one Rolls-Royce Continental IO-470). An Army Auster AOP.9 with a 260-b.h.p. IO-470 flat-six engine, wheel spats and strut fairings, XP254 first flew on Aug. 18. It is at present a private venture, and may be regarded as the start of a new line of development to give STOL capability, plus a rapid cruise performance, to the basic Mk.9 airframe. The example shown has the standard Army flare rack, loaded with four 20-lb. practice bombs, beneath the centre fuselage.

Beagle B.206X (two Rolls-Royce Continental IO-470-A). One of the two brand-new Farnborough exhibits this year, G-ARRM has been given an attractive bronze and white finish. It first flew on

The production-type Folland Gnat trainer with its longer nose; this aircraft is to be handed over to the C.F.S. after the show.



Maritime Central Airways' Dart Herald is to be seen with a nose radome.

About the Show . . .

Aug. 15 and had completed about 20 hours up to the time of its arrival at Farnborough. It has completed a brief programme of cross-wind landings up to 15 knots and 90° across the runway, has flown asymmetrically and has been rolled on numerous occasions.

Beagle-Miles M.117 (one Rolls-Royce Continental O.200A). In effect a single-engined version of the M.218, this project is shown as a model on the Beagle stand. Target first flight date is early next summer. Versions have been illustrated with both fixed and retractable undercarriages; the initial type is likely to have the former, and to have a 100-b.h.p. Rolls-Royce Continental engine.

Beagle-Miles M.218 (two Rolls-Royce Continental O-200A). A furnished cabin mock-up of this roomy four-seat light twin project is the central feature of the Beagle stand. Successor to the Gemini, with a retractable nosewheel undercarriage, the M.218 is to fly next year. The mock-up features a central panel of blind-flying instruments with radio installation to port, in contrast to the established layout.

Blackburn Beverley C.1 (four Bristol Siddeley Centaurus). Four of these tactical transports land at Farnborough during the R.A.F. display to disgorge over 200 troops, three Land Rovers and two Ferrets with their crews. A fifth is used by the six instructors from No. 1 Parachute Training School for their free-fall demonstration.

Blackburn B.103 Buccaneer S.1 (two de Havilland Gyron Junior 101). In its new all-white anti-flash finish, XK534 is the 18th (and latest to fly) of the pre-production batch of 20 Buccaneers, and incorporates production standard features. The first of the batch flew on Apr. 30, 1958 and No. 700Z Flight is now conducting intensive flying trials at Lossiemouth.

Bristol 188 (two de Havilland Gyron Junior DGJ.10). In the absence of the first full-scale 188 (XF923), which was rolled out for engine runs last April and expected to fly in mid-October, models are again displayed on the B.A.C. stand. Additional exhibits show the intake in detail, and examples of the puddle-welded structure.

de Havilland D.H. 106 Comet 4C (four Rolls-Royce Avon 525B). Shown in Middle East Airlines' colours, this Comet, G-AROV, is one of several completed by de Havilland against possible future sales.

de Havilland D.H.104 Dove 8 (two de Havilland Gipsy Queen 70 Mk.3). A company demonstration model of the executive type, G-ARDH, preserves unbroken the 16-year sequence of Dove appearances at S.B.A.C. displays.

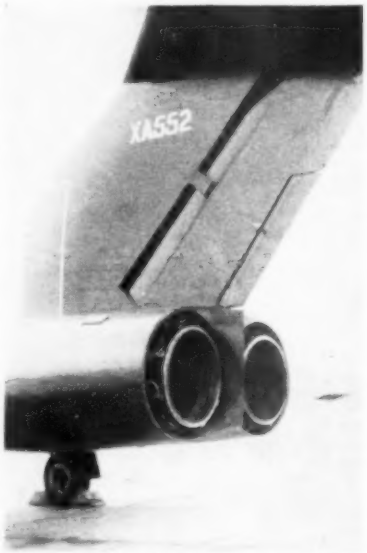
de Havilland D.H.110 Sea Vixen F.A.W.1 (two Rolls-Royce Avon 208). Two Sea Vixens from No. 899 Squadron demonstrate buddy flight refuelling. Ten from No. 890 Squadron on H.M.S. "Hermes" fly-past, and one of these demonstrates the LABS manœuvre.

de Havilland D.H.121 Trident (three Rolls-Royce Spey 505-5/10). Models and information on the Trident are on the Hawker Siddeley stand. Meanwhile, the first of 24 for B.E.A. (G-ARPA), rolled-out at Hatfield on Aug. 4, has completed preliminary engine runs with ground-running Speys in the centre and one side nacelle, and is soon to have flight engines fitted for flight trials to begin during the forthcoming winter.

de Havilland D.H.125 (two Bristol Siddeley Viper 20). Models of this twin-jet executive, announced early this year, are a new feature on the Hawker Siddeley stand.

English Electric P.1B Lightning F.1 (two Rolls-Royce Avon 210). Nine standard production Lightning 1s of No. 74 Squadron fly from the Farnborough runway for their daily aerobatic demonstration. This Mark is now out of production, having been followed by the F.2 (first flown Jly. 11) with the OR.946 integrated flight instrument system and provision for later Avon marks.

English Electric P.11 Lightning T.4 (two Rolls-Royce Avon 210). A production model of the Lightning trainer, XM.974, outwardly similar to the second prototype shown last year. The T.4 first flew on May 6, 1959 and about a dozen have now been delivered.



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Reheat tail pipes of the Gyron Juniors in the Javelin test-bed aircraft; these engines are the supersonic versions for the Bristol 188.

Fairey Gannet AEW.3 (one Bristol Siddeley Double Mamba 102). Four of these early warning aircraft from No. 849 Squadron fly from H.M.S. "Hermes" each day as part of the Royal Navy demonstration.

Flight Refuelling Meteor U.16 (two Rolls-Royce Derwent 8). This is the target drone conversion of the Meteor F.8; WH505 is shown in the static park with Perspex panels to reveal the electronics for remote control. Modifications include a 30-inch extension of the nose, and jettisonable camera nacelles at the wing tips.

Folland FO.144 Gnat T.1 (one Bristol Siddeley Orpheus 101). Two of the 14 pre-production Gnats, XM693 and XM698, shown for the first time with the new 62-gallon flush-fitting underwing tanks. The two-seat Gnat first flew on Aug. 3, 1959, and XM698 (the second to production standards, with TACAN, interim O.R.946 instrument layout, ac electrics, 1-ft. increase in nose length, and about 500 lb. additional fuel) is just about to be delivered to C.F.S., for training evaluation. The earlier aircraft, repainted in high-gloss white, has been undergoing preliminary spinning trials (six turns each way); and flutter excitation, using the R.A.E. rocket "bonkers," has also been explored. Thirteen of the 14 pre-production Gnat trainers are now flying, and with the new slipper tanks, Mach 1.17 has been achieved in a dive. The range of tailplane movement has been extended with the undercarriage down for additional longitudinal control at low speeds.

Gloster Javelin (two de Havilland Gyron Junior DGJ.10). Flight development of the supersonic, afterburning PS.50 version of the Gyron Junior has been under way in this converted Javelin 1, XA552, since Jan. 31. The engines are to power the Bristol 188 on its first flight in the near future.

Handley Page H.P.80 Victor B.2 (four Rolls-Royce Conway R.Co.11). A production example of the second mark of Victor, XL164. Trials with a Blue Steel stand-off bomb semi-submerged in the fuselage of a Victor 2 are under way at Boscombe Down. Victor 1s (Bristol Siddeley Sapphires) from Bomber Command take part in the daily contrail fly-past over Farnborough.

Handley Page H.P.115 (one Bristol Siddeley Viper ASV.9). First flown on Aug. 17, XP841 is one of the two completely new exhibits this year. Worthy of study are its control arrangements, with elevons on the narrow-delta wing; the camera pod on the fin, and the sturdy undercarriage.

Handley Page H.P.R.7 Herald 200 (two Rolls-Royce Dart 527). G-ARTC is a prototype model Herald 200, in Maritime Central Airways' markings. The indoor stand

(*Continued on page 313*)

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Gloster Javelin all-weather fighter
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Orpheus turbojet powers...
Fiat G 91 strike fighter
Fiat G 91 T trainer
Folland Gnat light fighter
Folland Gnat trainer
Fuji TIF 2 trainer
Hindustan HF 24 fighter

Viper turbojet powers...
De Havilland DH 125 executive transport
Piaggio/Douglas 808 executive transport
Hunting Jet Provost trainer
Macchi MB 326 trainer
GAF Fairey Jindivik target drone

Proteus turboprop powers...
Bristol Britannia airliner
Bristol Britannia military transport

Thor ramjet powers...
Bristol/Ferranti Bloodhound guided missile

Gamma rocket engine powers...
Saunders-Roe Black Knight space probe

Stentor rocket engine powers...
Avro Blue Steel stand-off bomb

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About the Show . . .

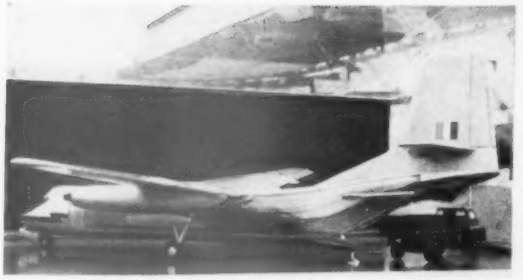
(*Continued from page 312*)

includes information on Herald variants including a military tactical transport with "flap-type" doors in the underside of the fuselage and Dart RDa.10s. This can carry 52 armed troops. Another model shows the H.P.R.8, the projected car-ferry and air bus version announced last year.

Hawker Hunter (one Rolls-Royce Avon 203). The R.A.F.'s participation at Farnborough includes the 16 Hunter F.6s of No. 92 Squadron—"The Blue Diamonds"—operating from Dunsfold: and the eight Hunter F(GA)9s of No. 54 Squadron.

Hawker P.1101 Hunter T.66A (one Rolls-Royce Avon 203). Hawker's demonstrator, G-APUX, makes its third Farnborough appearance.

Hawker P.1127 (one Bristol Siddeley 53 Pegasus). Regrettably absent from the outside aircraft park, the P.1127 is represented by models on the Hawker Siddeley and Bristol Siddeley stands. Since the first P.1127 (XP831) began its flight trials on Oct. 21, 1960, it has been joined by the second prototype, XP836. Both aircraft are being flown from Dunsfold—by Bill Bedford and Hugh Merewether—in a programme to "close the gap" with a full transition from the vertical to the horizontal flight mode.



A model of the military version of the Handley Page Herald showing its upswept tail and underside rear loading doors.

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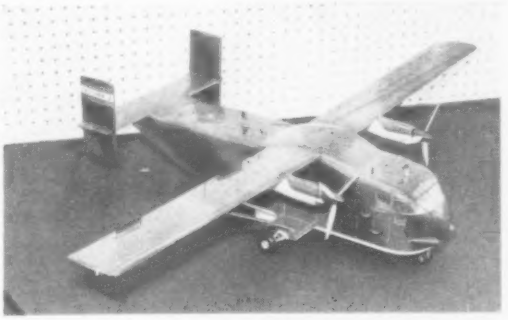


An interesting development to be seen on the Short stand is this model of an Astazou-powered Short Skyvan.

Hunting P.84 Jet Provost T.4 (one Bristol Siddeley Viper 201). The T.4 XP547 is a production model with the 2,500-lb. ASV.11 engine. The static park includes an armed Jet Provost T.51 (Viper 102) for the Sudan, the first of four. In the flying display, four Jet Provost T.3s (Viper 102) are used by the C.F.S. aerobatic team.

Scottish Aviation Twin Pioneer CC.Mk.2 (two Alvis Leonides 138). A late production model for the R.A.F., XP294. This Mk. has small structural differences with forgings and castings in place of some fabricated sheet metal and machined parts. From No. 230 Squadron, Twin Pioneer CC.Mk.1s take part in the tactical transport demonstration by No. 38 Group.

Scottish Aviation Pioneer CC.Mk.1 (one Alvis Leonides 503/7). No. 230 Squadron at Odiham supplies aircraft of this type for No. 38 Group's tactical transport demonstration.

Short SC.1 (five Rolls-Royce RB.108). This is the first SC.1, XG900, which appeared at Farnborough last year to give the first full public demonstration of a transition.

Short SC.5 Belfast (four Rolls-Royce Tyne RTy.12). Impressively demonstrating the size of this aircraft is an 11-ft. long section of the 17.5 ft.-diameter fuselage in the outside site. The upper deck is fully furnished and the lower deck has palletized freight. This section represents the SC.5/31 civil version, designed primarily for the North Atlantic, with a 100,000-lb. payload. Scale models of this variant are on Short's indoor stand, with a model of a fully automatic freight terminal, and a 1/24th scale model of the military Belfast, the SC.5/10, cut away to show typical loads.

Short SC.7 Skyvan (two Rolls-Royce Continental GTS IO-520). A model of this 9,300 lb. light freighter presages its appearance in the flying display next year. New this year is a model of the Skyvan II, projected for military use with Blackburn Astazou turboprops. This variant has a gross weight of 11,500 lb. and carries a 4,500-lb. payload for 370 naut. miles at 140-180 knots.

Supermarine 544 Scimitar F.1 (two Rolls-Royce Avon 202). The Royal Navy uses 16 Scimitars for its flying demonstration, with No. 800 Squadron flying from Farnborough and No. 804 Squadron from H.M.S. "Hermes."

Vickers VC10 (four Rolls-Royce Conway). Models and information on the B.A.C. stand show the two VC10 variants now under development—the 299,000-lb. basic VC10 (RCo 42/1 engines) and the 327,000-lb. Super VC10 (RCo 42/3 engines). The basic VC10 is now offered at a gross weight of 310,000 lb. The initial cabin pressure test on the first fuselage at 9 p.s.i. was made on Aug. 19.

Westland 192 Belvedere HC.1 (two Napier Gazelle 101). A production example from the Weston production line, XG459 is to the latest standard with powered controls and compound anhedral on the tailplane. In the R.A.F. display are Belvederes from the trials unit at Odiham. The first Belvedere flew on Jly. 5, 1958.

Westland Rotodyne (two Napier Eland). For the fourth year, the original prototype XE521, now known as the Rotodyne Y, is demonstrated. Models of the developed Rotodyne Z on the Westland stand, in B.E.A. and B.U.A. colours, show the larger, tapered wing and bigger fuselage, and the revised nacelle contours for the Tyne engines. Gross weight of the production version is now 60,000 lb.

Westland P.531 Scout (one Blackburn Nimbus). This is a pre-production model, XP165, for the Army Air Corps, on which the recently installed hydraulic power controls are being developed. These have resulted in a great improvement in stability and general handling, and the stick forces in manual reversion remain low. Maximum out-of-trim load in manual is only about 12 lb., compared with around 4 lb. with power. The Scout shown was due to go to the Blackburn company later in the week for the continuation of engine development.

Westland Skeeter AOP 12 (one de Havilland Gipsy Major 140). Eight of these light helicopters, production of which ended some time ago, are used by the Army Air Corps for their display. The Turmo-Skeeter test-bed, XM563, is also being shown.

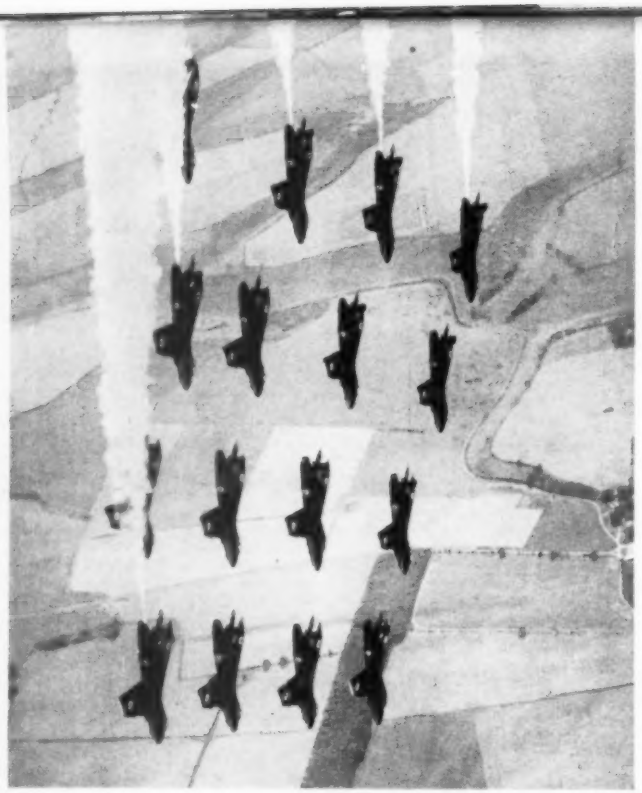
Westland Whirlwind Series 3 (one de Havilland Gnome H.1000). This designation distinguishes the Gnome-powered Whirlwind in civil guise: the company demonstrator G-APDY, has been converted from Leonides Major power. For the R.A.F., the Whirlwind HAR.10 with Gnome 101 is in production at Yeovil, and the Weston factory is converting older Whirlwinds to have the new engine. Whirlwind HAR.2s (P. & W. R-1340 engine) from No. 225 Squadron are used in the R.A.F.'s display. The civil Gnome-Whirlwind is furnished as an eight-passenger executive type, but is also equipped with a winch and bomb slip. The latter is being used to hoist a Citroen 2CV light truck during the display.

Westland WB.5 Wessex (one Napier Gazelle 161). The Wessex exhibit is, once again, a production HAS.1, XM300 with full auto stabilization, control and electronic equipment for the Royal Navy anti-submarine rôle. The first squadron, No. 815, commissioned with this type on Jly. 4, 1961. In due course the uprated Gazelle NGa.9 will be introduced in the Wessex HAS.3. The Wessex flown has a ventral attachment point for load towing, and is demonstrating its capability of pulling vehicles weighing nearly 50 tons. It is also fitted with a pick-up point for fully controlled hover from the ground. The indoor display refers to the Wessex 2, an Army variant with the Coupled Gnome engine. The prototype, with H1000 engines, is to fly soon, and H1200 engines will be available for production models next year. Further Wessex versions with the coupled engine are under development for other rôles.

A dominant exhibit in the outside equipment park is this section of the Short Belfast, showing typical passenger and freight accommodation.

About the Show . . . .

Flush of Diamonds



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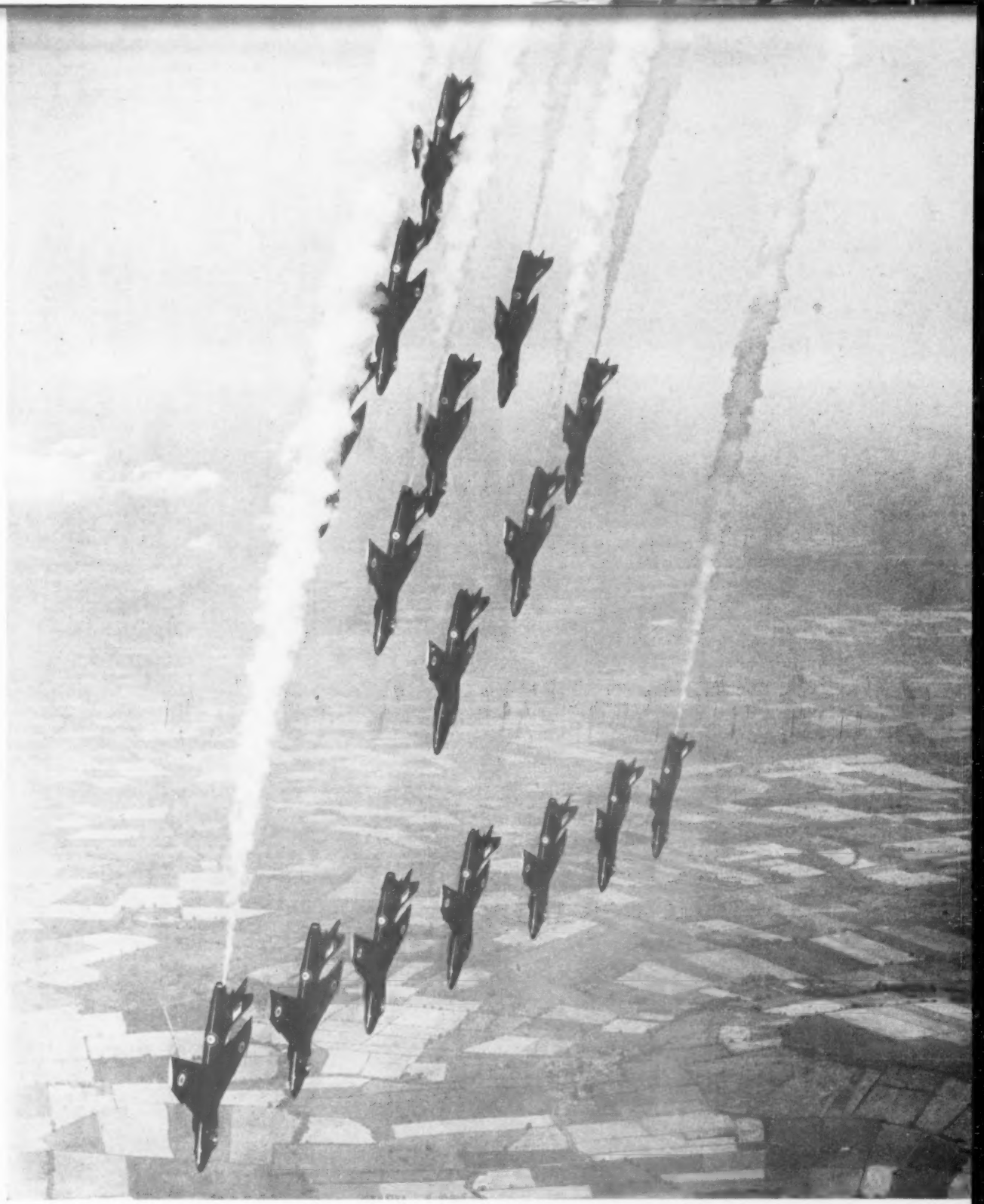


Led by Sqn. Ldr. Brian Mercer, "The Blue Diamonds" of No. 92 Squadron are presenting their Farnborough show with fourteen Hunter F.6s and two Hunter T.7s. Their display "shapes" include the diamond "T" (above), the diamond sixteen (top left), and the three-formation split loop (left).

About the Show . . .

Powerplants on Show

Astazou (Blackburn Engines, Ltd.). This highly successful Turboméca turboprop is shown by Blackburn for the first time, indicating the company's intention to produce it in this country in due course. For a weight of 271 lb., the Astazou develops 594 e.h.p. at sea level and 400 e.h.p. at 400 m.p.h. at 20,000 ft. A possible application is in the Short Skyvan 2.

Avon 524 (Rolls-Royce, Ltd.). This civil RA.29 from a B.O.A.C. Comet 4 has run for 3,184 hr. since last overhaul, and is one of the first engines in the current trials to achieve a 3,200-hr. overhaul period.

R-R Continental (Rolls-Royce, Ltd.). Examples are shown of the three engines in the Continental range which it is intended should be built in Britain. These are the 100-b.h.p. O-200A, the 145-b.h.p. O-300C and the 310-b.h.p. GIO-470A, the last-mentioned being the engine intended for the production model of the Beagle B.206. Information is presented on four other Continental engines, the 95-b.h.p. C-90, the 175-b.h.p. GO-300E, the 240-b.h.p. O-470A and the 260-b.h.p. IO-470D.

Conway RCo.42 (Rolls-Royce, Ltd.). An engineering mock-up of the latest civil Conway variant, which was first run last March. Specified for the VC10, the RCo.42/1 is now rated at 20,370 lb.s.t. minimum for take-off; the RCo.42/3 for the Super VC10 is rated at 21,825 lb. The RCo.42 is distinguished by a completely new low-pressure compressor and turbine system.

Dart 510 (Rolls-Royce, Ltd.). A standard RDa.7 is shown as extracted from a B.E.A. Viscount 802, with 2,983 hr. since last overhaul.

Eland 504A (Napier Aero-Engines, Ltd.). An "exploded" exhibit of the standard Eland powerplant for the Canadair 540 and Convairliner conversions.

Gamma 301 (Bristol Siddeley Engines, Ltd.). A new version of the rocket engine which in its Gamma 201 version has powered the 10 (100% successful) launchings of the Black Knight re-entry research vehicle. The combustion chambers have been modified to incorporate improvements derived from experience with the company's Stentor rocket. The changes lead to a longer rated life and simpler pre-flight preparations.

Gazelle 501 (Napier Aero-Engines, Ltd.). This designation refers to the civil variant of the Gazelle 101 which powers the Belvedere. At NGa.2 rating of 1,465 s.h.p., it is mounted in the vertical position. It is shown on the Napier stand as a complete engine change unit.

Gazelle 512 (Napier Aero-Engines, Ltd.). Shown for the first time is this civil helicopter powerplant designed for installation in any position from horizontal to vertical, with an axial intake and no reduction gearing. This engine has a maximum contingency (2½-min.) rating of 1,750 s.h.p., an intermediate (1-hr.) rating of 1,575 s.h.p. and a maximum continuous rating of 1,330 s.h.p. The F.A.A. take-off (5-min.) and en route failure (30-min.) rating is 1,640 s.h.p. Projected developments of this engine are the Gazelle 513 and 514, with max. contingency ratings of 1,925 s.h.p. and 2,000 s.h.p. respectively. The F.A.A. take-off ratings of these two variants will be 1,825 s.h.p. and 1,890 s.h.p.

Gnome 101 (de Havilland Engine Co., Ltd.). This is a standard Gnome H.1000 of the type in production for the Whirlwind HAR Mk. 10. The rated power is 1,050 s.h.p. and the full M.o.A. type approval was obtained in May. Flight trials in a Whirlwind began in the middle of 1959, and the first production Whirlwind 10 flew earlier this year. The 1,250-s.h.p. Gnome H.1200 has completed a 25-hour Special Category flight approval test and after flights in a Vertol 107 in the U.S. later this year will go into production for the Swedish Vertols and Agusta-Bell 204Bs.

Gnome H.1200 (de Havilland Engine Co., Ltd.). In its coupled form, comprising two Gnome H.1200s driving a single shaft through a common gearbox, this is the engine for the Westland Wessex 2, soon to fly. Initial flying trials will be with a Coupled Gnome H.1000, which was installed in a modified Wessex at Yeovil a few weeks ago.

Gnome P.1000 (de Havilland Engine Co., Ltd.). This turboprop version of the Gnome first ran last year and has completed 25 hr. It delivers 1,000 s.h.p. plus 144 lb. residual thrust.

Gyron Junior 101 (de Havilland Engine Co., Ltd.). An interim production engine at the DGJ.2 rating of 7,100 lb.s.t. plus the substantial percentage of bleed air needed for flaps and leading-edge blowing in the Buccaneer.

Leonides 531 (Alvis, Ltd.). A sectioned example of the standard Leonides as used in the Twin Pioneer.

Leonides Series 554 (Alvis, Ltd.). The long-stroke Leonides in its helicopter version, as used in the Bristol Sycamore and, without a clutch and fan, the Westland Widgeon. Take-off power is 640 b.h.p. The long-stroke engine first ran in October, 1957, and was type-tested in August, 1958.

Leonides Major Series 755/1 (Alvis, Ltd.). Helicopter version of the 14-cylinder two-row radial Alvis powerplant. Minimum take-off power, 755 s.h.p. First ran June, 1955.

Nimbus (Blackburn Engines, Ltd.). A production turboshaft version of the Nimbus for the Westland Scout. It is also available as a pure jet, and is to power the SRN.2 hovercraft.

Olympus R (Bristol Siddeley Engines, Ltd.). This exhibit appears to be similar to that last year of a BO1.21 with Solar reheat. Engines of this type are currently the subject of extensive ground testing and a further series of flight trials with a reheat Olympus will begin later this year, as part of the programme to develop the engine for the TSR2. Current production version is the 20,000-lb.s.t. Olympus 301.

Orpheus 803 (Bristol Siddeley Engines, Ltd.). A cut-away exhibit of the current production Orpheus for the Fiat G-91. This version is in production in Italy and Germany, while the lower-powered Orpheus 701 is built in India for the Gnat.

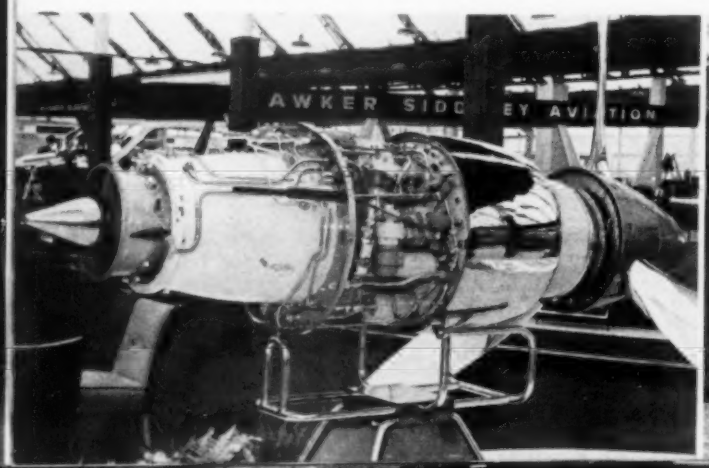
Pegasus (Bristol Siddeley Engines, Ltd.). An exhibition example of the BS.53 lift-thrust powerplant, as displayed earlier this year in Paris. The BS.53 first ran in August, 1959, and first flew, in the Hawker P.1127, on Oct. 21, 1960.

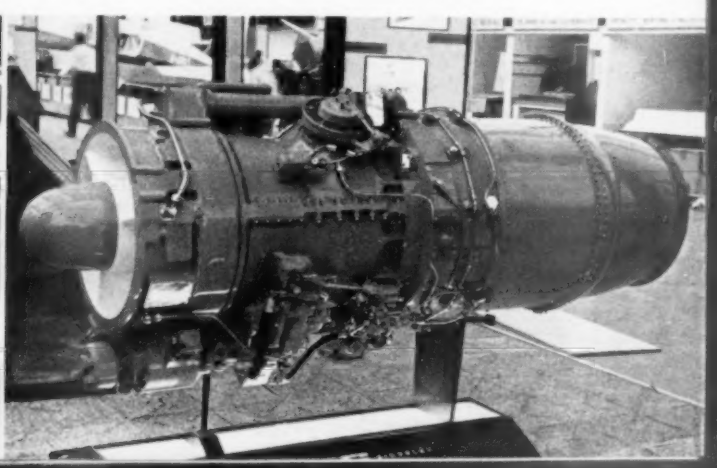
PR.37 (Bristol Siddeley Engines, Ltd.). One of the completely new engine exhibits this year, the PR.37 is one of the smallest rocket engines ever made for a practical application, with a maximum thrust of 170 lb. and a cruising thrust as low as 50 lb. The PR.37 has been designed for the Jindivik target to boost the operating altitude by as much as 10,000 ft. The installation comprises a pod under each wing containing the HTP and kerosene propellents, and a combustion chamber under the fuselage. Dry weight is 120 lb., and the weight of propellents, 325 lb.

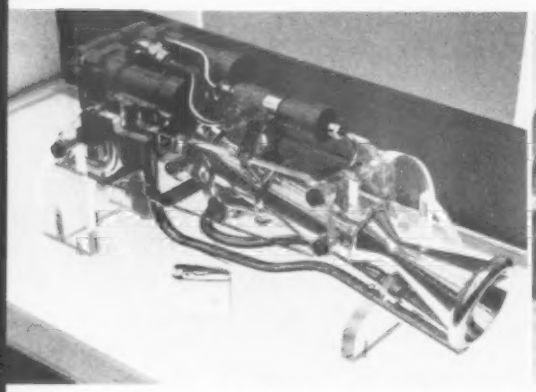
Proteus 705 (Bristol Siddeley Engines, Ltd.). Exhibited after completion of its full run of 2,400 hours in a Britannia 102. Over two million flying hours have been completed by Proteus engines.

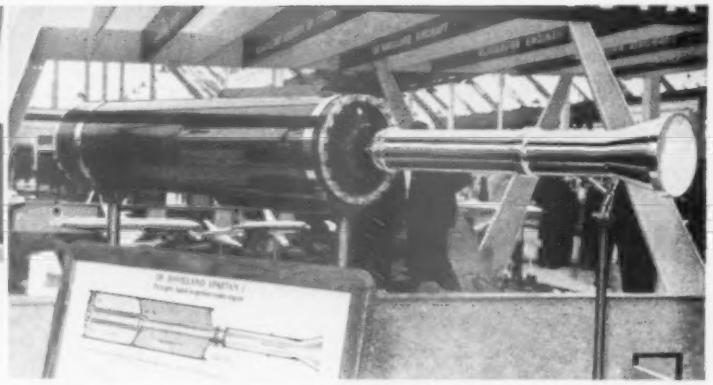
RB.108 (Rolls-Royce, Ltd.). Two of these jet-lift engines are shown in a non-swivelling mock-up fuselage installation, with doors over the intakes and outlets which are closed during forward flight, and a retractable cascade in front of the intake, to deflect air into the engines. This exhibit, with the RB.145, is part of a general presentation on VTOL/STOL which includes models of such aeroplanes as a delta-wing and a swept-wing tactical fighter and a tactical transport (see pages 336-7). The comparative sizes of jet-lift

Left, being shown for the first time—the Blackburn Astazou 594-e.h.p. turboprop. Right, a new version of the Bristol Siddeley Viper, the ASV. 20, which develops 3,000 lb.s.t.







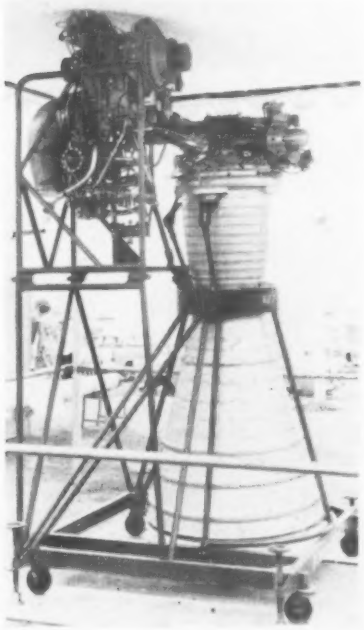


The diminutive Bristol Siddeley PR37 (note the cigarette lighter) liquid rocket motor for thrust boosting the Jindivik target; it develops 170 lb.s.t.

and fan-lift installations in a transport are shown, and there is a model of a thrust deflector as might be used on the propulsion engines of VTOL fighters to supplement the lift from the vertical engines.

RB.145 (Rolls-Royce, Ltd.). An example of this jet-lift engine is displayed. Developed from the RB.108, it has been test-run but not yet flown. Rated at 2,750 lb.s.t., it is reported to be the subject of current German interest.

RB.162 (Rolls-Royce, Ltd.). A jet-lift engine to which reference is made on the maker's stand. It is to be jointly developed in Britain, France and Germany. No specific details are available but the thrust/weight ratio has been reported to be 16 : 1, and the structure is said to include plastics components.



Above, the Rolls-Royce RZ.2 rocket motor, which is half the powerplant for Blue Streak, makes its first public appearance at Farnborough.

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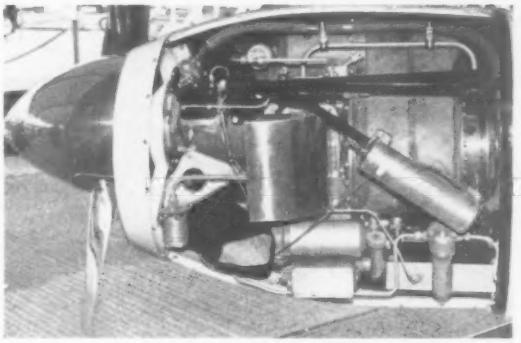
Right, seen for the first time at Farnborough is the Rolls-Royce Spey for the D.H. Trident.



Above, de Havilland's Spartan pre-packaged liquid rocket motor which can be used for missile propulsion or as an assisted take-off unit.

Left, Rover's neat little 90-h.p. turboprop engine for light aircraft.

Rover TP/90 (Rover Gas Turbines, Ltd.). Claimed to be the smallest turboprop used to date as an aircraft primary powerplant, the TP/90 is exhibited installed in a typical wing section. Flights have been made in the diminutive Currie Wot, with a hydraulically operated variable-pitch propeller.

RZ.2 (Rolls-Royce, Ltd.). This rocket engine is exhibited for the first time, with a full-size example in the outside missile park and a ¼-scale model of the paired Blue Streak installation on the indoor stand. Known as RZ.12 in its paired form, the engine delivers a sea-level thrust of 137,000 lb. More than 400 static firings of RZ.2 and the earlier RZ.1 have been made, and static firings of the twin RZ12 installation began at Spadeadam this year.

Spartan 1 (de Havilland Engine Co., Ltd.). A surprise exhibit, the Spartan is representative of the type of pre-packed liquid propellent rocket motors which the company can offer following an agreement with the U.S. Thiokol Chemical Corp. The Thiokol company has developed a range of these engines to power the Bullpup, Sparrow and other missiles, and under the terms of the agreement D.H. will be able to produce the engines in the U.K. The Spartan is suitable for use as a missile powerplant or for aircraft ATO purposes.

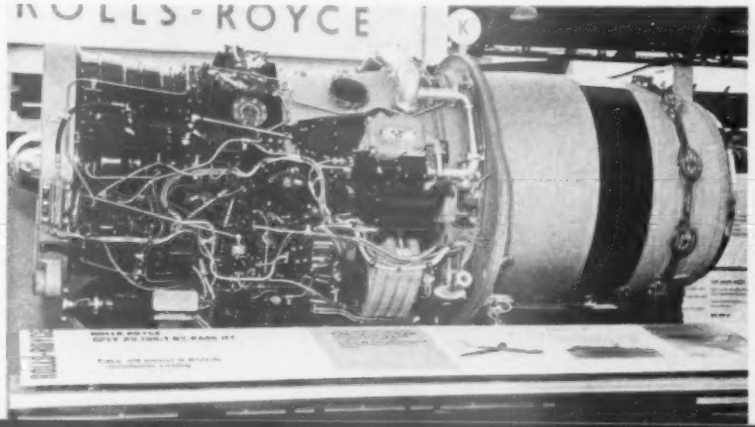
Spey RB.163-1 (Rolls-Royce Ltd.). Making its first Farnborough appearance, the Spey is about to start its flight tests in a Vulcan, prior to powering the D.H. Trident around the end of the year. First run was made in December, 1960, and two ground-running engines have been installed and run in the Trident recently. Civil variants are the Mk. 505-5/10 for the Trident and Mk. 505-14 for the B.A.C. One-Eleven, with a minimum rating of 9,850 lb. for take-off. A military variant (RB.168) is being developed to power the Blackburn Buccaneer S.Mk.2.

Stentor BSSt. 1-1 (Bristol Siddeley Engines, Ltd.). Powerplant for the Blue Steel stand-off bomb, the Stentor makes its second Farnborough appearance. Since its last Farnborough appearance it has completed a full M.o.A. type test.

Thor BT-1 (Bristol Siddeley Engines, Ltd.). A sectioned and an unsectioned example of the early Bloodhound engine are on show, mounted on a Bloodhound body.

Tyne 512 (Rolls-Royce, Ltd.). Complete with its 14-ft. 6-in. de Havilland propeller, a 5,325-e.h.p. Tyne R.Ty.11 of the type used in the T.C.A. Vanguard is on display.

Viper ASV.20 (Bristol Siddeley Engines, Ltd.). Specified for the D.H.125 and Piaggio-Douglas PD-808, this engine is shown as a mock-up; it has not yet run. Addition of a zero compressor stage increases the air mass-flow, and the static thrust of 3,000 lb. compares with the 2,500 lb. of the Viper 11 from which the Viper 20 has been developed.



About the Show . . .

Arriving at Farnborough

Photographs copyright "The Aeroplane and Astronautics"

Above, a centre of great attraction both on the ground and in the air is the Beagle B.206 light twin executive powered by Rolls-Royce Continentals; its elegant lines are well displayed in this view.

Right, the Folland Gnat light jet fighter trainer—powered by a Bristol Siddeley Orpheus—is being shown for the first time with its new underwing fuel tanks; this particular aircraft is one of the pre-production batch of 14.

Above, a distinctive new shape at Farnborough this year is the Handley Page H.P.115 research aircraft powered by a Bristol Siddeley Viper. It is intended for exploration of the low speed and landing characteristics of the type of wing planform likely to be used for supersonic civil transports.

Left, the new Beagle AOP.11 is another newcomer to Farnborough; it flew for the first time on Aug. 18 and is powered by a Rolls-Royce Continental flat-six engine.

Right, last year the second prototype of the Avon-powered English Electric Lightning T.4 trainer was shown. This year a production version is being displayed.

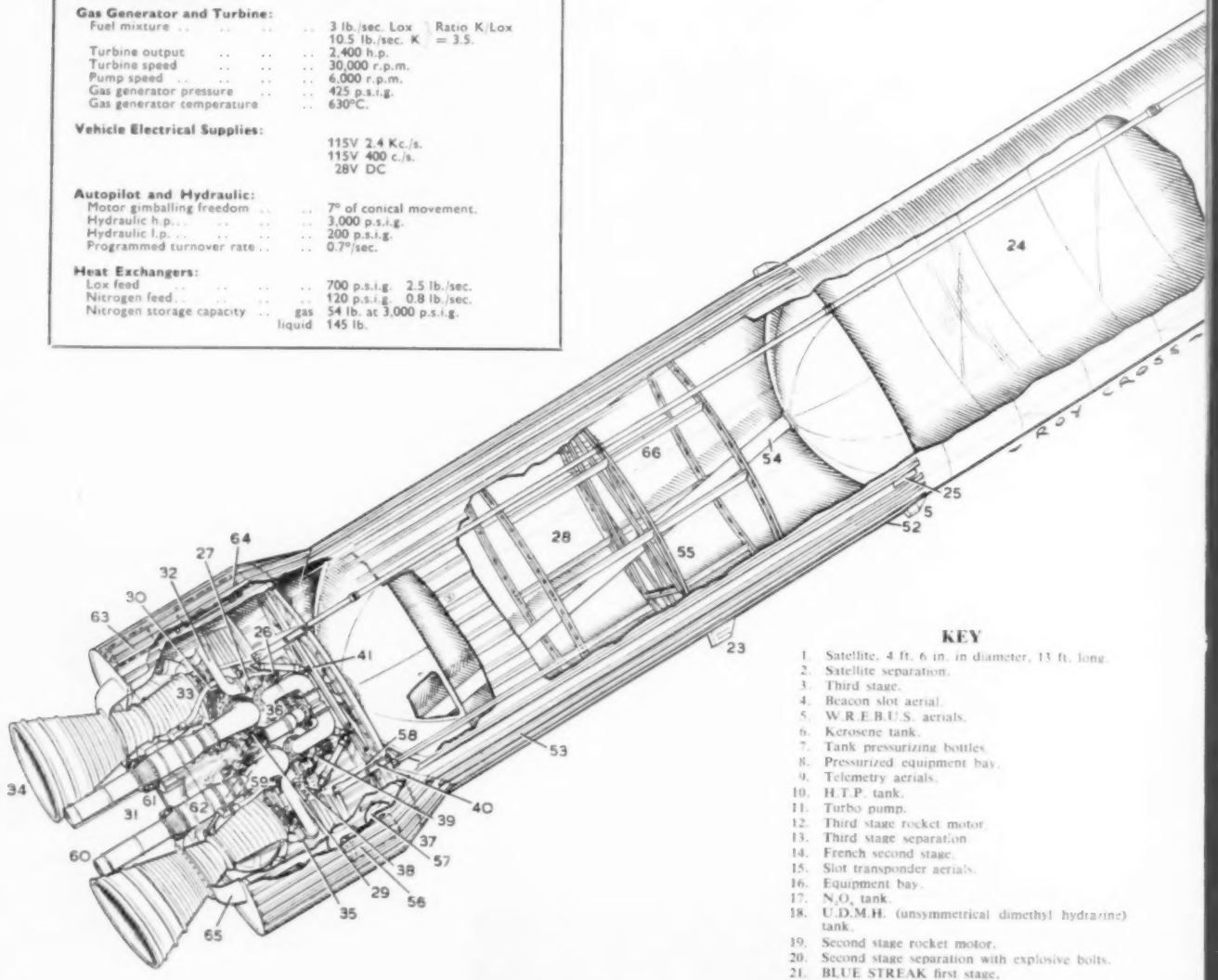
Left, a production Victor B.2, powered by Rolls-Royce Conways; other Victors in the flying display will be Sapphire-powered Victor B.1s of Bomber Command taking part in the R.A.F.'s massive contribution.

About the Show . . . .

EUROPE'S HEAVY SATELLITE LAUNCHER

TECHNICAL DATA ON D.H. BLUE STREAK (FIRST STAGE)

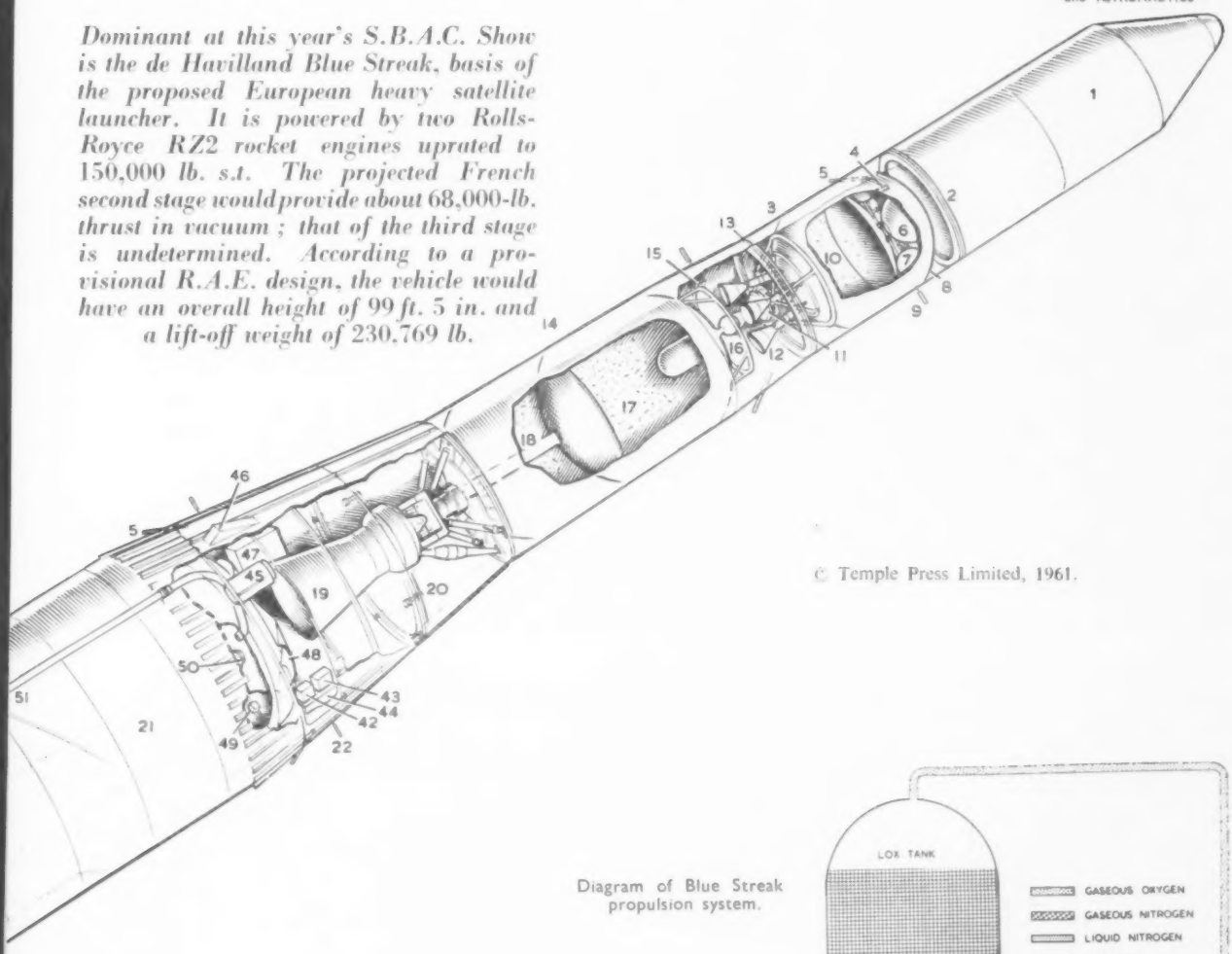
Vehicle Dimensions:	
Tank diameter	10 ft.
Overall length	61 ft. 6 in. (including engines).
Tank wall thickness	0.019 in.
Prop. bay length	6 ft. 3 in. (excluding engines).
Tank bay length	46 ft.
Vehicle Weights:	
Nominal launch	92.2 T.
Lox tank full	60.8 T.
Kerosene tank full	26.3 T.
All burnt weight	6.1 T.
Engine Data:	
Present thrust per engine	137,000 lb. (uprated thrust 150,000 lb.).
Engine duration	180 sec. (max.).
Fuel mixture. Lox/K	2.25/1 by weight.
Thrust chamber pressure at injector	525 p.s.i.g.
Lox System:	
Tank pressurization (full)	28.5 p.s.i.g.
Tank pressurization (empty)	4.3 p.s.i.g.
Lox pump maximum flow	390 lb./sec.
Lox pump delivery pressure	785 p.s.i.g.
Lox pump impeller diameter	11 in.
Kerosene System:	
Tank pressurization (full)	10.25 p.s.i.g.
Tank pressurization (empty)	1.5 p.s.i.g.
K pump maximum flow	170 lb./sec.
K pump delivery pressure	735 p.s.i.g.
K pump impeller diameter	12.5 in.
Gas Generator and Turbine:	
Fuel mixture	3 lb./sec. Lox | Ratio K/Lox = 3.5. 10.5 lb./sec. K
Turbine output	2,400 h.p.
Turbine speed	30,000 r.p.m.
Pump speed	6,000 r.p.m.
Gas generator pressure	425 p.s.i.g.
Gas generator temperature	630°C.
Vehicle Electrical Supplies:	115V 2.4 Kc./s. 115V 400 c./s. 28V DC
Autopilot and Hydraulic:	
Motor gimballing freedom	7° of conical movement.
Hydraulic h.p.	3,000 p.s.i.g.
Hydraulic l.p.	200 p.s.i.g.
Programmed turnover rate	0.7°/sec.
Heat Exchangers:	
Lox feed	700 p.s.i.g. 2.5 lb./sec.
Nitrogen feed	120 p.s.i.g. 0.8 lb./sec.
Nitrogen storage capacity	gas 54 lb. at 3,000 p.s.i.g. liquid 145 lb.



KEY

1. Satellite, 4 ft. 6 in. in diameter, 13 ft. long.
2. Satellite separation.
3. Third stage.
4. Beacon slot aerial.
5. W.R.E.B.U.S. aerials.
6. Kerosene tank.
7. Tank pressurizing bottles.
8. Pressurized equipment bay.
9. Telemetry aerials.
10. H.T.P. tank.
11. Turbo pump.
12. Third stage rocket motor.
13. Third stage separation.
14. French second stage.
15. Slot transponder aerials.
16. Equipment bay.
17. N_2O_4 tank.
18. U.D.M.H. (unsymmetrical dimethyl hydrazine) tank.
19. Second stage rocket motor.
20. Second stage separation with explosive bolts.
21. BLUE STREAK first stage.
22. 465 telemetry aerials.

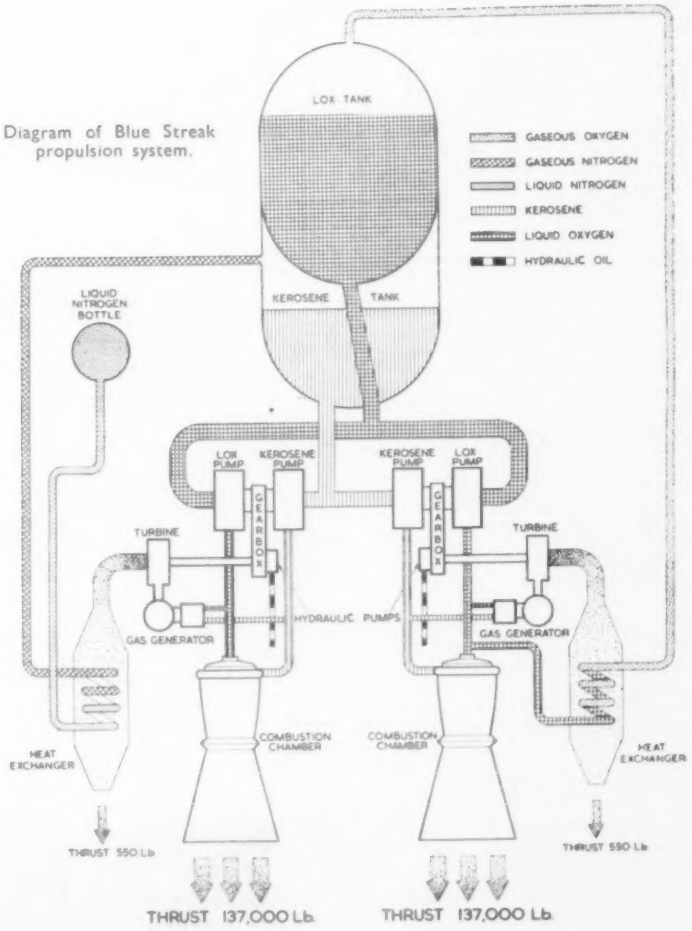
Dominant at this year's S.B.A.C. Show is the de Havilland Blue Streak, basis of the proposed European heavy satellite launcher. It is powered by two Rolls-Royce RZ2 rocket engines uprated to 150,000 lb. s.t. The projected French second stage would provide about 68,000-lb. thrust in vacuum; that of the third stage is undetermined. According to a provisional R.A.E. design, the vehicle would have an overall height of 99 ft. 5 in. and a lift-off weight of 230,769 lb.

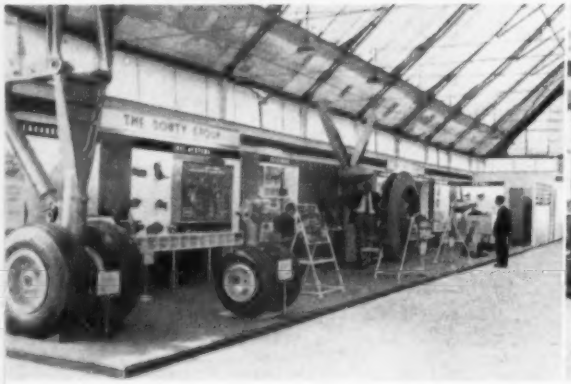


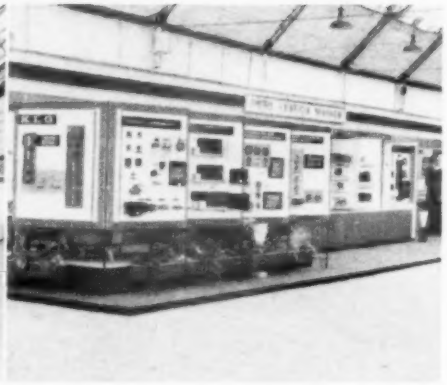
© Temple Press Limited, 1961.

23. Yaw rate gyro.
24. Liquid oxygen tank.
25. Break-up charges.
26. Pneumatic manifold.
27. Engine relay box.
28. Kerosene fuel tank.
29. Turbine assembly.
30. Main Lox line (behind).
31. RZ.12 propulsion bay.
32. Main fuel line.
33. Fuel inlet manifold.
34. Thrust chambers.
35. Main fuel valve.
36. Fuel pump.
37. Equipment pannier.
38. Gimbal bearing blocks.
39. Lox pump (behind).
40. Propulsion bay attachment point.
41. Thrust chambers support girder.
42. Power box.
43. Transistorized receiver.
44. Battery box.
45. Telemetry transmitter.
46. Electrical probe.
47. Alternative container.
48. Motor baffle.
49. Lox tank junction box.
50. Vent valve (Lox).
51. Lox pressurization pipe.
52. Kerosene pressurization pipe.
53. External stringers.
54. Lox stand pipe.
55. Stiffening rings.
56. Auto-pilot canister.
57. Nitrogen bottles.
58. Engine support beam.
59. Pitch jack (dotted).
60. Turbine exhausts.
61. Turbine exhaust deflection hinge points.
62. Heat exchangers.
63. Instrumentation distribution box.
64. Telemetry switch unit.
65. Thrust chamber flexible seal.
66. Anti-quake baffles.

Diagram of Blue Streak propulsion system.

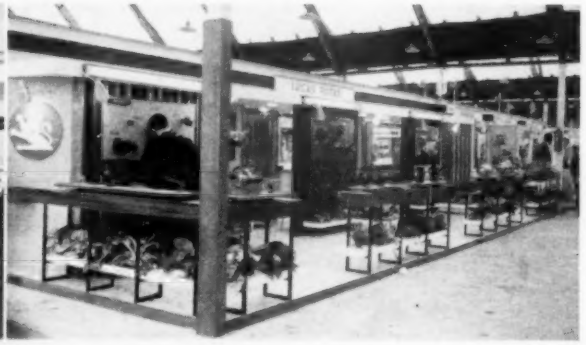


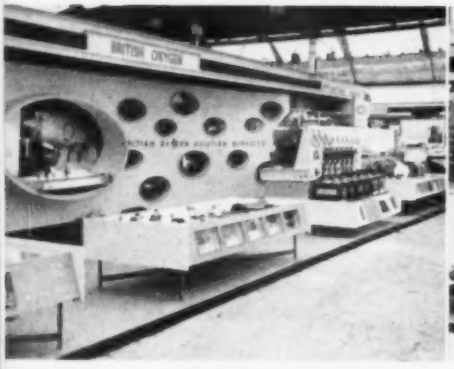


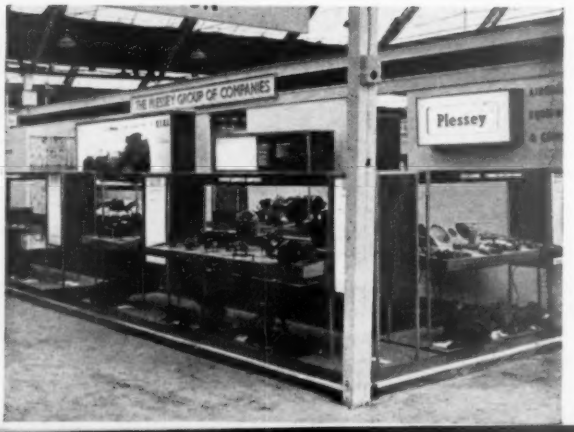


Some of the Stands

With more floor space and some 300 stands occupied by specialist manufacturers of materials, components and accessories, the static display inside the big marquee is bigger than ever before.







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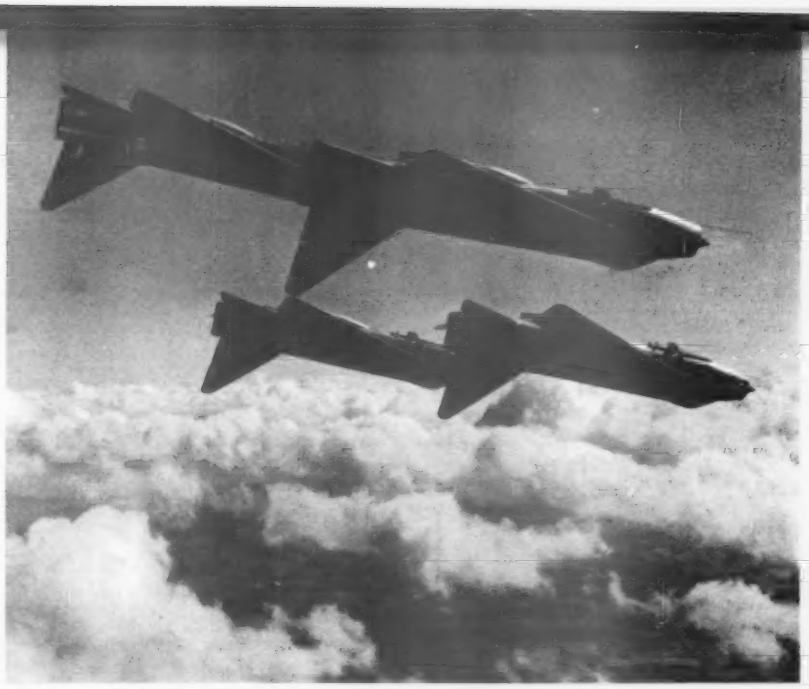
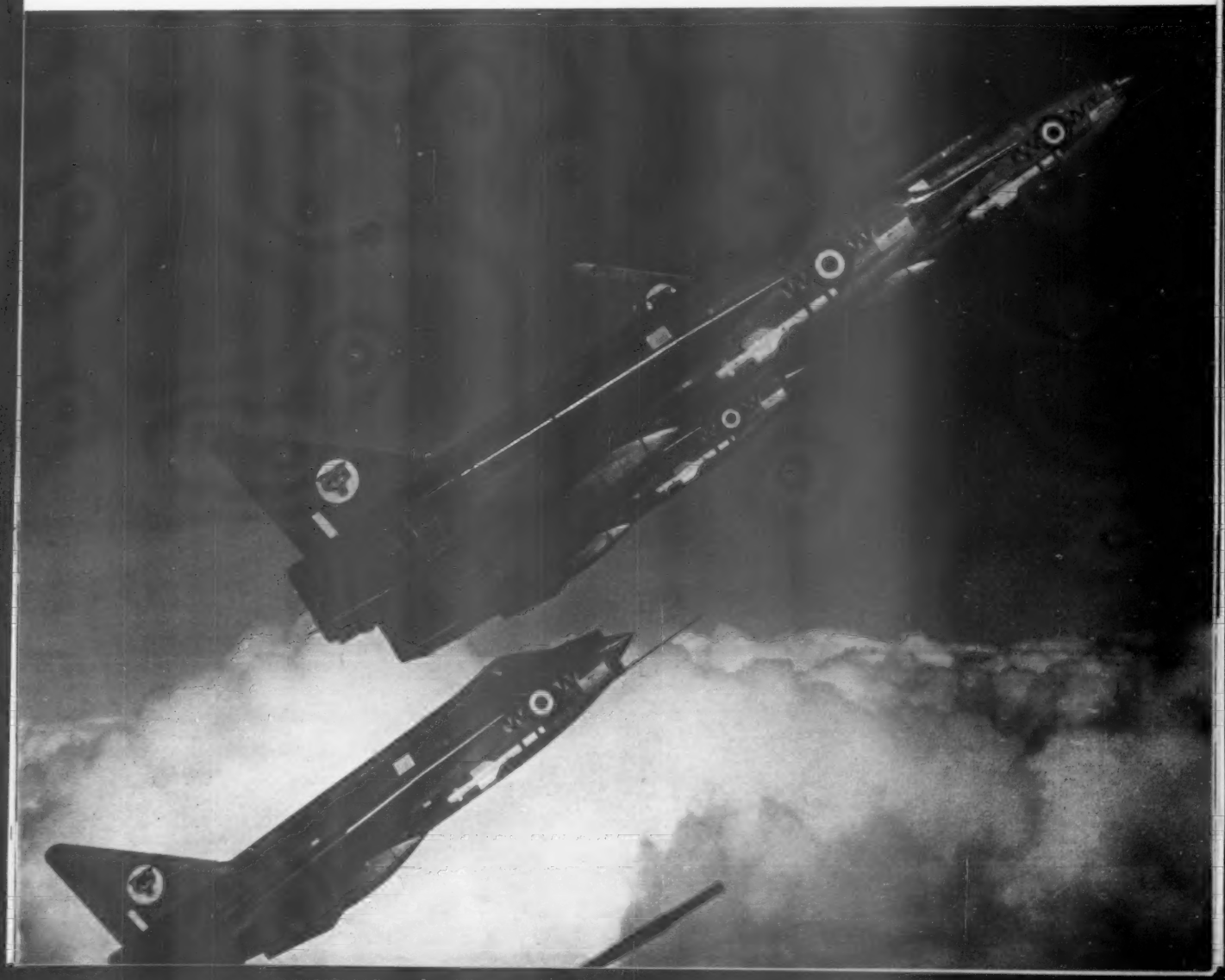
About the Show . . .

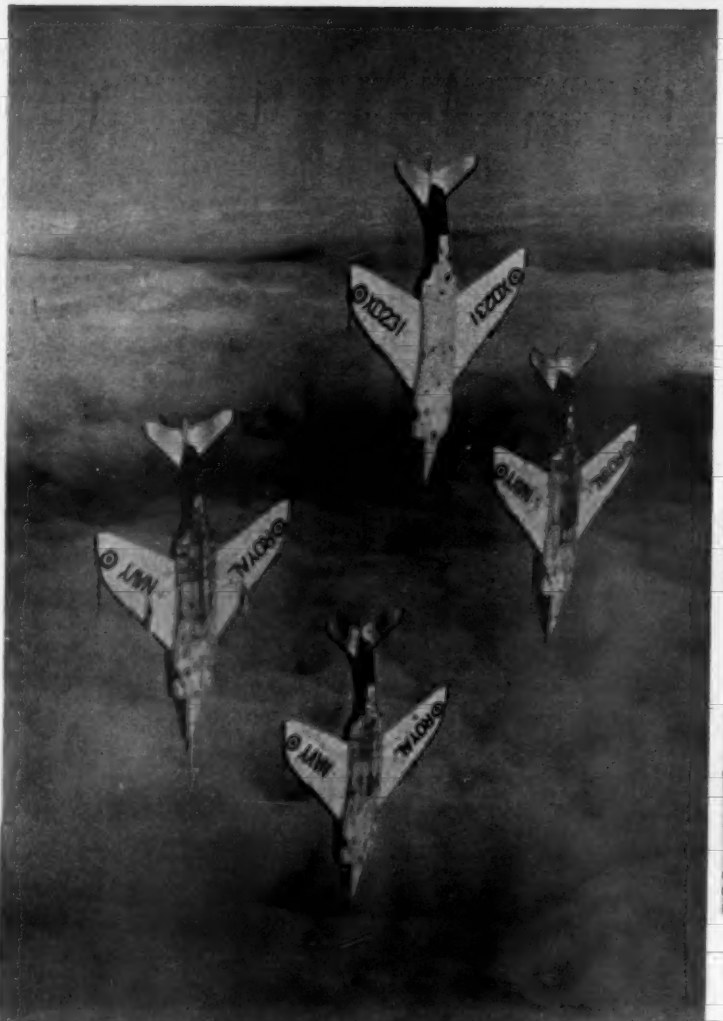
UP AND OVER

Photographs by A. E. Long copyright "The Aeroplane and Astronautics"



One of the three R.A.F. aerobatic performances in the flying display is by Lightnings of No. 74 Squadron. Led by Sqn. Ldr. J. F. C. Howe, a "Tiger Four" is seen here above the East Anglian countryside.





Practising to Perfect

Scimitars of No. 800 Squadron are providing the formation aerobatics in the Royal Navy's display at Farnborough. Here, they are seen working-up over R.N.A.S. Lossiemouth.

Photographs by A. E. Long copyright the "The Aeroplane and Astronautics".

About the Show . . .

Below, led by Lieut. Cdr. D. Norman, No. 800 Squadron pilots flying in the show are (left to right): Lieuts. J. Manley, C. Morris, G. Johnston; Lieut. Cdr. W. Fairhead; Lieut. C. Giles; Lieut. Cdr. D. Norman, C.O.; Lieut. T. Skead; Lieut. Cdr. J. Ford, Senior Pilot; and Lieuts. A. Goodenough, P. Banfield and J. Carver.

About the Show . . .

In the Pilot's Seat

On these pages are noted all the industry's test pilots taking part in the flying display—according to the latest information available at the time of going to press. For ease of reference they are listed in alphabetical order under the companies concerned.

ARMSTRONG WHITWORTH AIRCRAFT

W. H. Else.—Senior test pilot. Fighter and fighter-bomber pilot during War. Later seconded to A. and A.E.E., Boscombe Down, for armament trials. Joined Armstrong Whitworth as test pilot in 1947.—**Argosy C.1.**

E. G. Franklin.—Chief test pilot. Born 1920. Joined company as apprentice 1937. Flying training 1938. War service with Bomber and Pathfinder units and also as test pilot with Handley Page and A. and A.E.E., Boscombe Down. E.T.P.S. 1944. Rejoined A.W.A. as test pilot 1945; appointed chief test pilot 1948.—**Argosy C.1.**

BLACKBURN AIRCRAFT

G. R. I. Parker.—Experimental test pilot. Born 1918. Cranwell boy entrant. Served with Army Co-op. and F.A.A. before pilot training 1944. Destroyed nine enemy aircraft and five flying bombs. Test pilot R.A.E. 1945-48. Joined General Aircraft 1948; pilot on first flight of Blackburn-built H.P. 88.—**Buccaneer S.1.**

D. J. Whitehead.—Chief test pilot. Born 1925. R.A.F. Wings 1945. Transferred to F.A.A.E.T.P.S. 1954. Naval test squadron, A. and A.E.E., Boscombe Down, 1955. Retired from Navy 1958 to join Blackburn; appointed chief test pilot a year later.—**Buccaneer S.1.**

BRISTOL SIDDELEY ENGINES

T. P. Frost.—Chief test pilot. Born 1923. Flying training 1943. C.F.S. instructors' course 1947. E.T.P.S. 1952. A. and A.E.E., Boscombe Down, 1953-55. Joined Armstrong Siddeley Motors as chief test pilot 1955.—**Vulcan B.2.**

J. Pollitt.—Assistant chief test pilot. Born 1934. Joined R.A.F. 1951. Instructor at C.F.S. Joined Armstrong Siddeley Motors in 1956 as Sapphire engine development test pilot; appointed assistant chief test pilot 1959.—**Vulcan B.2.**

BRITISH EXECUTIVE AND GENERAL AVIATION

H. T. Howard.—Senior pilot and engineer in charge, flight trials, Beagle-Auster. Born 1927. Flying training with Nottingham U.A.S. 1944-48 while studying aeronautical engineering at Loughborough College. R.A.F. Wings 1949. Joined Auster 1951 as aerodynamicist; became chief aerodynamicist 1959.—**Airedale.**

W. T. L. John.—S.A.T.C.O. Shoreham and communications pilot. Born 1933. Pilot training with flying club 1954.—**Terrier.**

J. W. C. Judge.—Airport manager, Shoreham, and test pilot. Service with R.A.F. 1939-45 and R.Aux.A.F. 1945-50. Test pilot Vickers-Supermarine 1950-59 and with Rolls-Royce 1959-60. Joined Beagle-Miles 1961.—**Terrier.**

J. M. Nicholson.—Group manager, flight operations. Born 1922. R.A.F. service with Middle East, Flying Training and Transport Commands. Graduate of C.F.S. and A. and A.E.E., Boscombe Down, test pilot. Chief test pilot, de Havilland Engines 1957-61. Joined Beagle June this year.—**B.206.**

R. Porteous.—Sales director and chief test pilot, Beagle-Auster. Born 1916. Joined R.A.F. Reserve 1937. Instructor and junior test pilot with Phillips and Powis (Miles) 1938-39. President, Central Examination Board, Rhodesian Air Training Group 1944-45. C.F.I. and secretary, Derby Aero Club 1947-48. Joined Auster 1948.—**A.O.P.11.**

DE HAVILLAND ENGINES

P. Barlow.—Test pilot. Born 1926. Royal Navy 1942-58. Flying training 1949-51. E.T.P.S. 1953-54. Naval test squadron A. and A.E.E., Boscombe Down, 1954-57. Participated in initial carrier trials of Sea Vixen. Retired from Navy in 1958 to join de Havilland.—**Gyron Junior Javelin.**

ENGLISH ELECTRIC AVIATION

R. P. Beamont.—Special director and manager, flight operations, English Electric Aviation; deputy chief test pilot, British Aircraft Corporation. Born 1920. Fighter Command 1939-46; ten enemy aircraft and 32 flying bombs destroyed. Joined English Electric from Gloster 1947; as chief test pilot made first flights in Canberra and Lightning prototypes.—**Lightning T.4.**

J. L. Dell.—Chief test pilot. Born 1924. R.A.F. pilot training 1943. Flying and gunnery instructor 1943-49. C.F.E. 1950. Exchange posting with U.S.A.F. flying Sabres 1952-54. Sqn. Cdr., Fighter Weapons School, 1954-57. Attached to English Electric as Lightning project officer 1957. C.O., A.F.D.S., C.F.E., 1959. Left R.A.F. to join English Electric as deputy chief test pilot 1959.—**Lightning T.4.**

FOLLAND AIRCRAFT

M. Oliver.—Test pilot. Born 1922. Joined R.A.F. 1939. Flew with Fighter Command. R.Aux.A.F. 1947. Joined Folland 1957.—**Gnat Trainer.**

E. A. Tennant.—Chief test pilot. Born 1922. R.A.F. Wings 1941. By end of War flew 250 sorties in Defiants and Typhoons. E.T.P.S. to Boscombe Down in 1950. Joined Folland in 1953.—**Gnat Trainer.**

C. Allen

H. T. Howard

J. W. C. Judge

J. M. Nicholson

G. R. I. Parker

J. Pollitt

T. P. Frost

J. L. Dell

L. M. Whittington.—Test pilot. R.A.F. Wings 1943 then service with Coastal Command. Empire Flying School 1947. C.F.S. Course 1947-48. E.T.P.S. 1950. Boscombe Down 1951-53. Set up London-Karachi and London-Darwin records in Canberra PR.3 in 1953. Joined English Electric and subsequently joined Folland 1955.—**Gnat Trainer.**

HANDLEY PAGE

J. W. Allam.—Deputy chief test pilot. Born 1924. R.A.F. service 1943-54. Personal pilot to Air Marshal R. L. R. Atcherley when C.-in-C. Pakistan Air Force. E.T.P.S. 1950 and No. 5 course at U.S. Navy Test Pilots' Training Division. A and A.E.E., Boscombe Down, 1951-53. Joined Handley Page 1954; was pilot of first Victor to exceed Mach 1.—**Victor B.2.**

H. G. Hazelden

H. G. H. Merewether

R. N. Rumbelow

D. Tayler

A. F. C. Roberts

P. R. D. Wilson

L. C. E. de Vigne

J. G. P. Morton

P. P. Baker.—Test pilot. Born 1925. Joined R.A.F. 1943. Flew Sunderlands 1946-49. C.F.S. 1949. F.T.S. instructor 1950-52. E.T.P.S. 1953 and A. and A.E.E., Boscombe Down, 1954-56. E.T.P.S. tutor 1957-59. Joined Handley Page 1959.—**Victor B.2.**

H. G. Hazelden.—Chief test pilot. Born 1915. Joined R.A.F.V.R. 1939. Two ops. tours on bombers. No. 1 course E.T.P.S. 1943. Heavy Aircraft Test Sqn., A. and A.E.E., Boscombe Down, 1944; C.O. of Sqn. 1945—later, C.O. of Civil Aircraft Test Section. Test pilot, Handley Page, April, 1947; chief test pilot three months later; was pilot on first flights of Hermes 4 and 5, Sapphire-Hastings, Victor B.1 and both Leonides- and Dart-powered Heralds.—**Dart Herald.**

Sqn. Ldr. J. Henderson, R.A.F.—Aero Flight, R.A.E. Bedford. Born 1931. Joined R.A.F. 1950. Cranwell 1951-53. C.F.S. 1953-54. C.F.S. staff instructor 1954-56. E.T.P.S. 1959 then posted to R.A.E. Bedford.—**H.P.115.**

P. Murphy.—Test pilot. Born 1927. R.A.F. Wings 1947. Served with Nos. 56 and 66 Sqns. 1948-51. Experimental test pilot with Vickers-Armstrongs, 1951-58, on Valiants and Viscounts. Joined Handley Page 1958.—**Victor B.2.**

H. W. Rayner.—Test pilot. Born 1929. Rhodesian Air Training Group 1948. R.A.F. 1950. Brookland Aviation, Northampton, 1954. Armstrong Siddeley Motors, Bitteswell, 1955. Joined Handley Page 1960.—**Victor B.2.**

M. A. Thomson.—Test pilot. Born 1936. R.A.F. service 1954-58. Joined Handley Page 1959.—**Dart Herald.**

HAWKER AIRCRAFT

A. W. Bedford.—Chief test pilot. Born 1920. Joined R.A.F. 1940. Instructor 1945-49. Empire Flying School, and graduate and tutor E.T.P.S. 1949-50. Test pilot at R.A.E., Farnborough, 1950-51. Left R.A.F. and joined Hawker as experimental test pilot; became chief test pilot, 1956. Set up London-Rome and return speed records 1956; has held British and U.K. gliding records and is A.R.B.-approved glider test pilot.—**Hunter Trainer.**

D. Lockspeiser.—Test pilot. Born 1927. Joined R.A.F. 1949. Served with Nos. 118 and 245 Sqns. Released to join Hawker in 1955.—**Hunter Trainer.**

H. G. H. Merewether.—Deputy chief test pilot. Born 1924. Served with Royal Navy 1943-45. Vickers-Armstrongs 1948-53. Joined Hawker as test pilot 1954.—**Hunter Trainer.**

HUNTING AIRCRAFT

S. B. Oliver.—Chief test pilot. Born 1924. Joined R.A.F. 1942. Transferred to F.A.A. 1945. Instructors course, C.F.S., 1946. E.T.P.S. 1950. Joined Hunting in 1954 and has since shared in development test flying of Jet Provost.—**Jet Provost T.4.**

R. N. Rumbelow.—Test pilot. Born 1930. Joined R.A.F. 1951. Winner of Wright Jubilee Aerobatic Trophy 1956. Joined Hunting 1957.—**Jet Provost T.4.**

A. V. ROE

C. Allen.—Test pilot. R.A.F. 1943-47. Airline flying with C.A.A. and B.E.A. Joined Vickers-Armstrongs 1952 and spent six years as a production and experimental test pilot flying Valiants and Viscounts. Joined Avro 1959.—**Avro 748.**

J. G. Harrison.—Chief test pilot. Born 1918. R.A.F. Halton 1935-37. Commissioned 1942. War service as instructor and with 605 Sqn. Test pilot R.A.E., Farnborough, 1950-52. Joined Avro 1954.—**Avro 748.**

SHORT BROTHERS AND HARLAND

A. F. C. Roberts.—Test pilot. R.A.F. service 1953-57. Joined Shorts and has since been responsible for development and production flight testing of Canberra PR.9s and high altitude phase of Canberra U.10. Flew SB.5 and later transferred to SC.1 programme; has completed more than 40 transitions to date.—**SC.1.**

D. Tayler.—Chief test pilot. Born 1920. Joined R.A.F. 1939. Service with Bomber and Pathfinder units. Attached to R.A.E., Farnborough, 1945, to ferry German aircraft to England. Joined R.A.E. as civilian test pilot 1946. Joined Shorts as chief test pilot 1961. Has flown more than 150 types and was first to fly SB.5 with 69° sweepback.—**SC.1.**

WESTLAND AIRCRAFT

L.C.E. de Vigne.—Test pilot. Born 1915. R.A.F. service 1940-51. Three ops. tours, one on Spitfires and two with Pathfinder Mosquito Sqn. E.T.P.S. 1947. Service and civilian test pilot, R.A.E., Farnborough, 1948-52. Chief test pilot Armstrong Siddeley Motors 1952-53. Joined Westland, 1953.—**Gnome Whirlwind 3.**

W. R. Gellatly.—Test pilot. Born 1920. Joined R.N.Z.A.F. 1940. Permanent commission R.A.F. 1947. E.T.P.S. 1950. Helicopter flight commander, A and A.E.E., Boscombe Down, 1951-54. Pilot to H.R.H. Duke of Edinburgh on first Royal helicopter flights. Joined Fairey Aviation as chief helicopter pilot 1955.—**Rotodyne.**

C. T. D. Hosegood.—Chief test pilot, Bristol division. Born 1921. Joined F.A.A. 1939. Served on first CAM ship. Helicopter flying training in U.S.A. 1944. Helicopter experimental unit, Beaulieu 1945-46. Joined Bristol Aeroplane Co. 1948, became chief helicopter test pilot 1951.—**Belvedere HC.1.**

J. G. P. Morton.—Test pilot. Born 1925. Joined R.N. 1943. A. and A.E.E., Boscombe Down 1952-54. Joined Fairey Aviation 1955.—**Rotodyne.**

K. M. Reed.—Test pilot. Born 1921. With Imperial Airways until joining F.A.A. 1941. Helicopter flying training in U.S.A. 1943. Formed first Royal Navy helicopter Sqn. 1945. Joined Westland as senior helicopter test pilot 1949. Joined Saunders-Roe 1952; became chief helicopter test pilot 1958.—**Scout.**

W. H. Sear.—Westland Group chief test pilot. Born 1923. Joined R.A.F. 1942. Transferred to F.A.A. 1945. E.T.P.S. 1951 and A. and A.E.E., Boscombe Down. Seconded to Westland 1953 and appointed chief test pilot 1955; responsible for all early development test flying of Wessex and Westminster.—**Wessex HAS.1.**

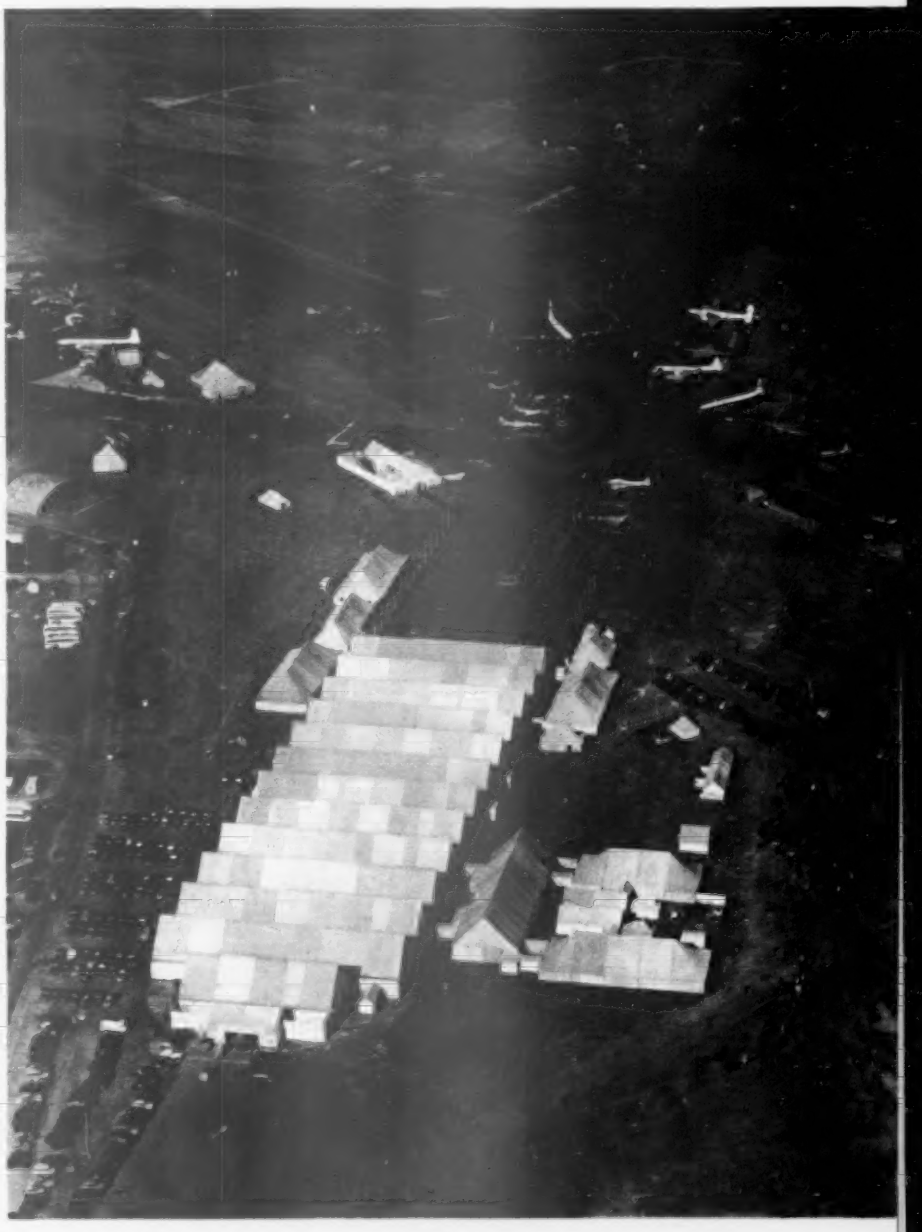
P. R. D. Wilson.—Test pilot. Regular Army 1939-52. Helicopter test pilot at Beaulieu experimental unit 1949-52. Joined Bristol 1952.—**Belvedere HC.1.**

15 YEARS OF S.B.A.C. SHOWS . . .

1947 Among the aircraft lined up at Radlett were (above): Hastings, Hermes 2, Ambassador, Tudor VII, Lincoln, Aerocar, Concordia, Sturgeon 1, Brigand, Lincoln, Bristol 170, Nimbus, Newbury Eon, Olympia, Wyvern, Autocrat, Auster 6, Prentice, Merganser, Messenger, Aerovan, Gemini, Miles M.68, Merchantman, Marathon, Heston A.2/45, Meteor, Firefly Trainer, Firefly 4, Attacker, Valetta, Balliol, Blackburn S.28/43, Sea Fury, Desford, Vampire, D.H. 108, Chipmunk, Dove, Ghost-Lancastrian, Consul (2), Viking, Proctor, Buckmaster, Firebrand, Dove, Hornet, Mosquito, Vampire, Sea Otter, Spitfire Trainer, Proctor seaplane, Pioneer 1, G.A.L.56 (2), Gyrodyne, Fury (Sabre), Fury (Centaurus) and assorted sailplanes.

1948 At the first Farnborough Show (left): (Foreground group) Ghost Vampire, Vampire 5, Skeeter, Sycamore, Gyrodyne, Satellite, Super Ace, Sea Hawk, Air Horse, A.W.52, G.A.L.61, Proctor 4 and 5, Elliotts Primary, Prentice, Firebrand, Firefly 5, Seagull, Consul, Sturgeon 2, Valetta. (Runway group) Newbury Eon, Elliotts Baby, Olympia, Hornet, Sea Fury, Spitfire, Firefly Trainer, Blackburn S.28/43, Brigand, Sturgeon, Athena, Bristol 170, Dove, Marathon, Valetta, Theseus-Lincoln, Lincoln 2, Hastings, Avis, Autocrat, Auster A.2/45, Balliol, Primer, Sealand, Ambassador, Avon-Lancastrian, Nomad-Lincoln, Chipmunk, Prentice, Pioneer, Auster 7, Primer, Aerocar, Viscount, Nene-Viking, Hawker P.1040, Vampire 5, Meteor 4 and 7, Tudor 8, A.W.52, Hermes 4.

1952 Among the aircraft to be seen (right) are the Meteor 11, Aiglet Trainer, Auster B/4, Avro 707A, Avro 707B, Shackleton, Britannia, Sycamore, Bristol 173, Bristol 170, Vampire 11, Venom 1, Venom 2, Sea Venom 20, Venom (with reheat), Comet 1, Comet 1A, Heron, Canberra 4, Canberra 5, Canberra (Sapphire), Canberra (Olympus), Canberra (Avon reheat), Gannet 1, Meteor 7, Marathon, Sea Hawk, Hunter, Provost 1, Prince, Pioneer 2, Sperrin, Swift 1, Supermarine 508, Viscount, Varsity, Wyvern, Dragonfly.

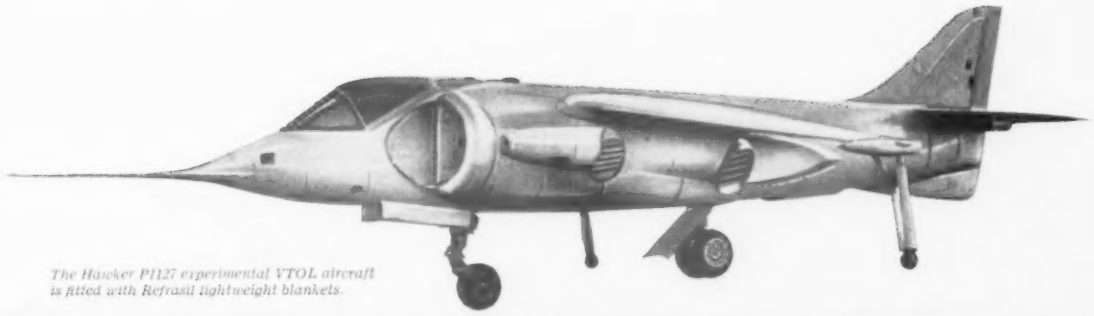


Presented here and overleaf are selected pictures of past S.B.A.C. shows. At the top of this page is the line-up of aircraft at Radlett in 1947—the second of two post-War shows at the Handley Page airfield. Left, is a view of the first display at Farnborough in 1948, with the static exhibition in the R.A.E. hangars (lower left). In 1952 (above), the big marquee was pitched on one of the Farnborough runways. The aircraft visible in these three pictures are listed above.

S.B.A.C. SHOWS . . .

1954 At Farnborough in 1954 the marquee was moved to its present position on the hill to the left foreground of this picture, and the companies' tented caravans (left and centre) had begun to make their appearance. Aircraft visible here include: Shackleton, Firefly 9, Gannet, Canberra, Chipmunk, Aiglet Trainer, Provost (3), Beverley, Short SB5, Whirlwind, Bristol 170, Pembroke, Dove, Sea Venom, Venom (2), Vampire, Javelin (5), Sea Vixen, Sherpa, Seamew (2), Comet (2), Viscount, Canberra (2), Valiant, Vulcan, Eland-Varsity, Jet Provost, Pioneer 2, Balliol, Beaver, Heron, Meteor (3), Gannet (2), Fairey FD1, Sea Hawk, Hunter (2), Swift (3), Supermarine 525.

1956 Farnborough in 1956, with the marquee on its permanent site and the terraced belvederes well established. Aircraft in this picture are as follows: Tyne-Lincoln, Gyron-Sperrin, Britannia 301, Vulcan 1, Sycamore, Pioneer 2, Twin Pioneer, Viscount, Whirlwind, Widgeon (2), Fairey Ultra-light, Skeeter (2), Aiglet Trainer, Herald, Hunter (5), Javelin (3), Jet Provost (2), Seamew, Twin Pioneer, Canberra (2), Comet C.2, Dove, Gannet (2), Firefly 9, Swift (2), Pembroke, Prince, Sea Hawk, Heron, Gnat, Fairey FD2 (2), Scimitar, Sea Vixen, Beverley, Sea Venom, Venom, Vampire, Auster 9.



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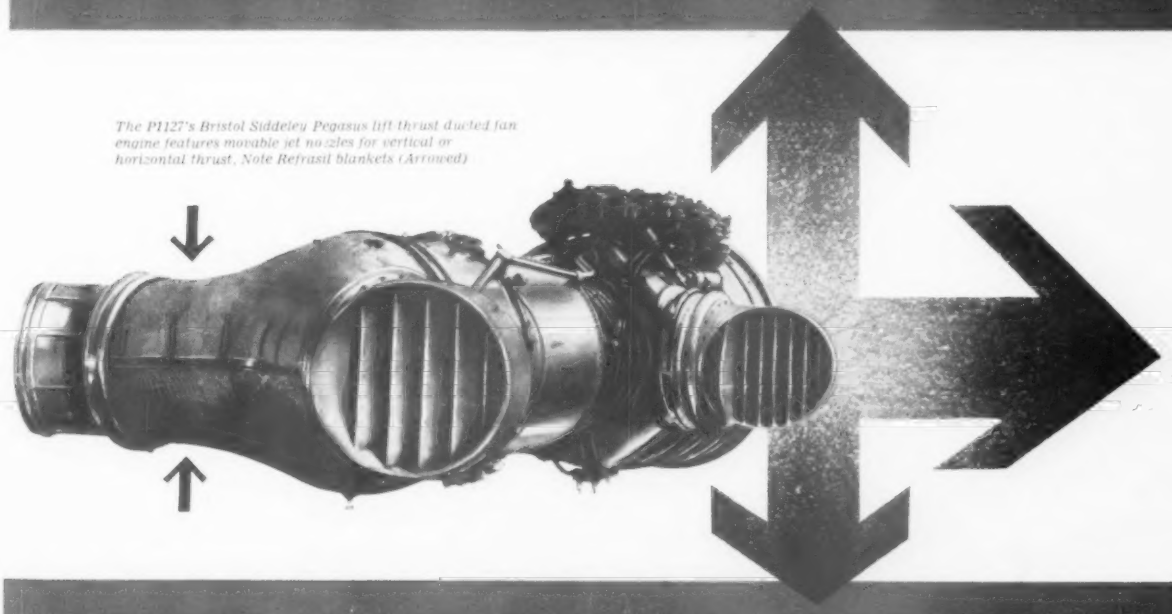

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(right) Vandervell Bushes are installed in actuating mechanisms for power assisted controls operating ailerons and tail plane.

Armstrong Whitworth Argosy Type AW 650 Freight-Liner
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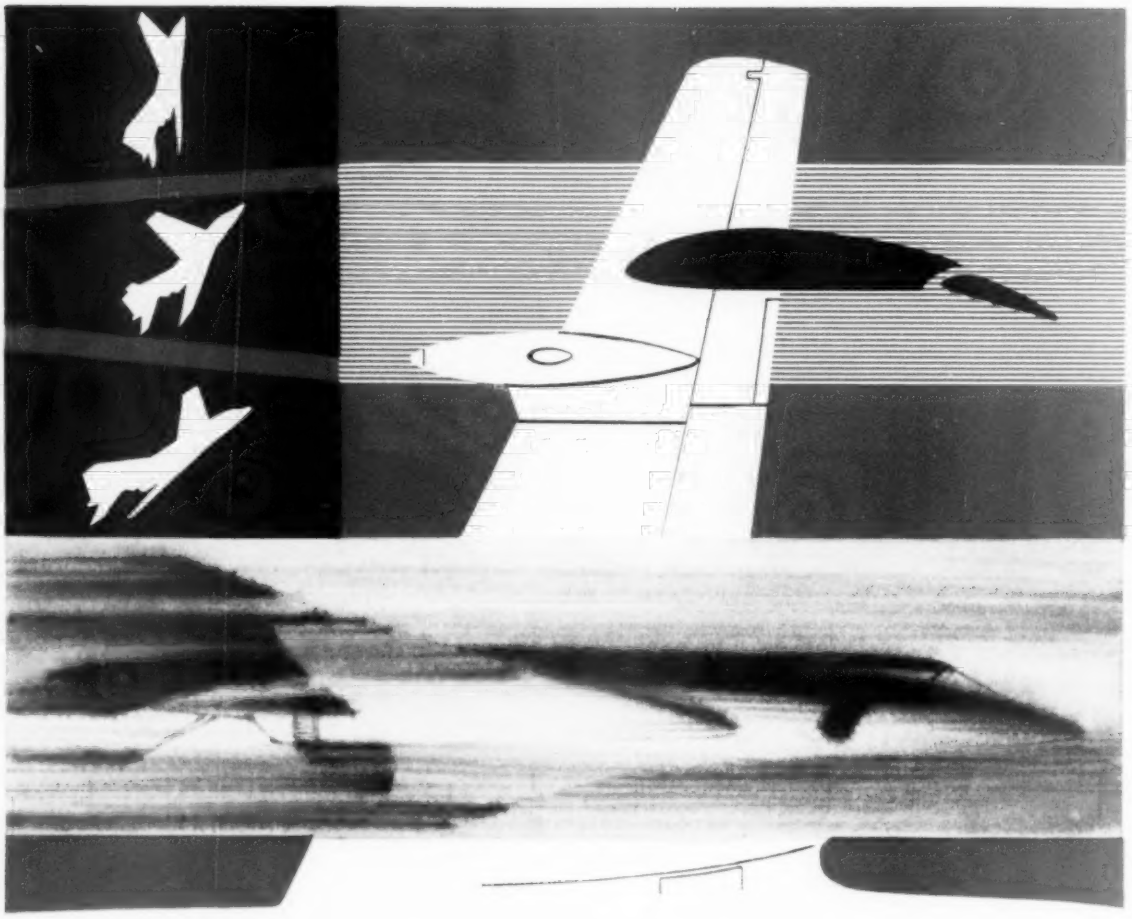

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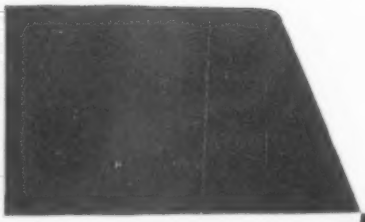

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The Fighting Services

Battle of Britain Displays

FORMATION aerobatics will be the highlight at many displays to be held on Battle of Britain day, Saturday, Sept. 16, when 16 R.A.F. stations will be "at home" to the public.

The Fighter Command aerobatic team—the "Blue Diamonds" of No. 92 Squadron (Sqn. Ldr. B. P. W. Mercer)—flying 12 Hunters, is to give three displays. Operating from R.A.F. Waterbeach, the team will open with a 10-minute show at Gaydon at 14.05 hrs.; it will be over Biggin Hill at about 15.40 hrs. and will land there after its display. Later the team will take off and fly back to Waterbeach for its third show.

Based at Coltishall, the Lightning F.1 team of No. 74 Squadron (Sqn. Ldr. J. Howe) will also be at Biggin Hill for an eight-minute display, and individual Lightnings will be demonstrated at Abingdon, Waterbeach, Waddington, Finningley and Cottesmore. Biggin Hill will also see the Central Flying School team of four Jet Provost T.3s led by Flt. Lt. F. Brambley, which will later give another performance at Tangmere.

Four Hunters from No. 229 Operational Conversion Unit, Chivenor, will provide shows at St. Athan and their home base; Gaydon, St. Athan and Colerne will each have a display by four Vampires of the Central Flying School, and another four Vampires from No. 1 F.T.S., Linton-on-Ouse, will perform at Leuchars and Middleton St. George. Three Jet Provosts from No. 2 F.T.S., Syerston, will also fly at these two stations.

Yet another team to be at Biggin Hill is a four-Vampire formation from No. 5 F.T.S., Oakington. This school will also have teams giving shows at Valley and Aldergrove. The aerobatic team of the R.A.F. College, Cranwell, composed of three Vampires, will fly at Cottesmore, Waddington and Finningley. A team of three Meteors from the R.A.F. Flying College, Manby, will give shows at Tangmere and Colerne.

Chipmunks are also to be seen in formation flying and aerobatic displays. Three from the University of London Air Squadron, White Waltham, will demonstrate at Waterbeach; three from Liverpool U.A.S. will be at Abingdon; the Birmingham U.A.S. will put up three at Tangmere, and three from Leeds U.A.S. are to perform at Middleton St. George. Four Chipmunks from St. Andrews U.A.S. will be at Leuchars.

Individual displays by Hunters of the 2nd Tactical Air Force, Germany, will be given at Coltishall, Waddington and Cottesmore, and the veteran Hurricane and Spitfire are to fly at Waddington, Cottesmore, Waterbeach and Coltishall.

Eight Royal Navy Scimitars from R.N.A.S. Lossiemouth are to give an aerobatic display at Gaydon, and the U.S.A.F. team of Super Sabres—the "Skyblazers"—will provide 10-minute displays both at Biggin Hill and Coltishall. Other U.S.A.F. contributions to the day's flying will include two Super Sabres from Lakenheath at Valley, Aldergrove and Leuchars, and two Voodoos from Bentwaters will fly at Biggin Hill, Tangmere, Abingdon, St. Athan and Chivenor.

The Battle of Britain Week London exhibition will be held in the Air Ministry, Whitehall, and outside in Richmond Terrace. It will be open daily from Saturday, Sept. 9, to Sunday, Sept. 17, from 10.00 hrs. to 19.00 hrs.

A new feature of the exhibition this year will be the display of the Schneider Trophy won by the R.A.F. High Speed Flight in 1927 and 1929 and finally in 1931. Another highlight will be the reproduction of a complete Fighter Command sector operations room as manned in the Battle. The static display will include a Hurricane, two Spitfires, Hunter, Javelin, Jet Provost, Firestreak AAMs and a Bloodhound SAM. There will be exhibits of equipment and a general photographic exhibition.

Continued Success

THE R.A.F. Reserves Club in South Street, Mayfair, has once again had a successful 12 months. In the Annual Report it is recorded that the club has just completed its thirteenth year, and in providing first-class amenities for its members at most reasonable subscription rates, has succeeded in the most important of its original intentions—that of keeping alive the spirit of friendship which originated during the War years.

Membership of the club is not confined to serving and ex-R.A.F. members. There is keen interest and support from the aviation industry generally, and from those with any interest in flying in the widest sense. Several organizations connected with the profession are also associated with the club, and members of the airborne forces are also to be seen using the club's headquarters.

Although there is a large membership, the committee is willing to accept a limited number of new members upon application.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Gp. Capt. F. D. Hughes, D.S.O., D.F.C., A.F.C., and Wg. Cdr. G. C. Cairns, A.F.C., to the Department of the Chief of the Air Staff.

Bomber Command: Wg. Cdr. G. A. Martin, D.F.C., A.F.C., to Headquarters as Deputy Senior Personnel Staff Officer; Wg. Cdr. W. E. D. Makin, D.F.C., to R.A.F. Driffield, as Senior Technical Officer; Sqn. Ldr. A. Barrell, M.B.E., to R.A.F. Gaydon, as Chief Ground Instructor, with the acting rank of Wg. Cdr.

Fighter Command: Wg. Cdr. D. R. Wilson to the Central Fighter Establishment for operational duties.

Transport Command: Wg. Cdr. J. J. Barr to No. 47 Squadron, R.A.F. Abingdon, to command.

Flying Training Command: Wg. Cdr. J. H. King to the R.A.F. Selection Board, Cranwell, as Deputy President.

Technical Training Command: Wg. Cdr. C. W. Thompson to No. 1 Radio School, R.A.F. Locking, as Educational Specialist in the Apprentice Radio Training Wing.

Maintenance Command: Gp. Capt. S. J. Bryant to No. 7 Maintenance Unit, R.A.F. Quedgeley, to command.

Royal Air Force, Germany: Gp. Capt. J. O. Gale to Headquarters as Senior Equipment Staff Officer; Gp. Capt. P. de L. Le Cheminant, D.F.C., to R.A.F. Geilenkirchen, to command.

Near East Air Force (Cyprus): Wg. Cdr. O. B. Parker to Headquarters as Command Armament Officer.

Far East Air Force: Wg. Cdr. K. Lister, D.F.C., to Headquarters as Deputy Senior Personnel Staff Officer.

Other Appointments: Wg. Cdr. G. H. Smith-Parr to Allied Air Forces Central Europe, for airfield engineering duties; Wg. Cdr. F. N. Brinsden to Melbourne, Australia, for duties with the United Kingdom Research Supply Staff.

CANADIAN SHOW.—As recorded in our previous issue, three Victor B.1s of No. 55 Squadron, R.A.F. Honington, left the U.K. on Aug. 27 to fly to Canada to take part in the Canadian International Air Show at Toronto on Sept. 1 and 2. Here the C.O. and force commander, Wg. Cdr. R. G. Wilson (fourth from left) is seen with his crew: (l. to r.) Flt. Lt. E. Butcher (A.E.O.); Flt. Lt. P. G. Cullen (nav./plotter); Flt. Lt. A. D. Stracey (co-pilot); Flt. Lt. D. A. Schofield (nav./radio); and the Squadron Engineering Officer, Flt. Lt. C. B. H. McNiven.

Photograph copyright "The Aeroplane and Astronautics"

Flying the Canadair Trainer

No. 104 in the Series by John Fricker

CANADAIR'S CL-41 is a new attempt to provide an "all-through" jet trainer, and, from the recent interest displayed by the R.C.A.F., one which seems likely to meet the challenge of this difficult specification with rather more success than its predecessors. Although laid down and designed in close collaboration with the R.C.A.F., the CL-41 is entirely a Canadair private venture, aimed at a wider market than merely national requirements. The European section of this market is currently being more intensively explored by the prototype CL-41, which is visiting Sweden, Germany, the Netherlands, Belgium and Switzerland, after teams from these and other countries had been to Canada for a preliminary evaluation.

Since its first flight on Jan. 13, 1960, the CL-41 has completed well over 200 hours in the air, in the hands of 60 or so pilots from many different countries. Its flight development has been achieved with an almost complete lack of modification and an unusually high degree of serviceability.

An R.C.A.F. evaluation team was able to take over after it had completed only 20 hours' flying, and put in a further 12 hours within four days. After that, it seemed to be a question not of whether the R.C.A.F. would have the CL-41, but rather a case of when and how many.

The answer seems to be: soon, and a couple of hundred to start with, probably including some of the advanced CL-41R version, carrying the electronics of the CF-104 or F-104G. Between them, the CL-41A and the CL-41R should be able to handle all but the operational stages of pilot training, and even these are catered for by the projected CL-41G. All CL-41s have a 500-lb. pick-up point beneath each wing for the attachment of drop tanks for ferrying, and these may be replaced by more offensive stores, in conjunction with cockpit sighting and selection equipment. The CL-41G has an additional under-fuselage attachment point, and a max. weight of 9,800 lb.

After spending a couple of days with the CL-41 prototype, still in its experimental civil markings, CF-LTW-X, at Frankfurt before its European tour, and enjoying an extensive exploration of its handling, I gained a clearer picture of its situation in the international trainer market. This was helped by a study of the CL-41 specification requirements, which set out "the attainment of an aeroplane safe throughout its flight envelope in the hands of student pilots in the initial stages of training."

It was to be docile and easy to handle, especially at low speeds near the ground, in the take-off and landing phases, and yet must have a design diving speed high enough to demonstrate and experience the effects of compressibility. The CL-41 meets these requirements with a sea-level stalling speed of only 75 m.p.h., and yet will achieve 475 m.p.h. in level flight at 30,000 ft. It can be dived to an E.A.S. of 500 knots, which becomes the Mach limit of 0.8 at around 30,000 ft.

No marked trim changes were to be apparent at least up to M=0.75, and the stall was to be mild enough, after adequate warning, for simple recovery by inexperienced pilots. Spin requirements were to Spec. MIL-S-25015 for Cat. 2 (primary training) aircraft, and the CL-41 meets both British and American criteria in this respect. Straightforward spinning characteristics were ensured by the selection of a T-tail, giving a completely unblanketed rudder, and the stowage of all fuel in fuselage tanks close to the C.G.

Stability and control were to conform to both trainer and fighter classes, in Spec. MIL-F-8785 (ASG) with unboosted controls. An ultimate manœuvring load factor of 11*g* was specified, to provide an ample margin for aerobatic training, while, for safe belly-landing and ditching capability, the cockpit structure was to withstand an ultimate load of 32*g*. The cockpit and centre fuselage are built up on two very strong beams and, coupled with the slow-speed handling of the CL-41, give a forced-landing capability which permits the use of very light, simple and unsophisticated ejection seats.

This simplicity is inherent in the CL-41 airframe, which nevertheless uses one or two novel techniques. These are principally concerned with the use of chemical milling and honeycomb sandwich construction in appropriate areas for the optimum structural efficiency and long service life. All the control surfaces, for example, except the rudder, and the single-slotted flaps, are built-up from honeycomb sandwiches for stiffness, and have the minimum of internal structure.

The prototype CL-41 employs moulded glass-fibre for part of the cheek intake ducts, which are guarded against debris ingestion on the ground by retractable mesh screens, operating in conjunction with the undercarriage. Powerplant is a Pratt & Whitney JT12 (J60) turbojet, which develops 3,000 lb. s.t. at its military rating, but in the CL-41 is throttle-stopped at 95% r.p.m., to deliver 2,400 lb. thrust. This means that a similar figure can always be guaranteed for take-off, in tropical or high-altitude conditions, while the conservative rating gives the new JT12 (the CL-41 was the first aircraft solely powered by this engine) an initial overhaul life of some 800 hours.

The CL-41 was designed for the Fairchild J83, which was cancelled along with its missile, and the GE J85 was also considered before installation of the J60-P. A happy marriage has undoubtedly been achieved between engine and airframe, and the JT12 has proved particularly uncritical in relight performance. The air-start button on the throttle may be pressed at any r.p.m., after a flame-out, and at a wide range of airspeeds. The CL-41 was also designed with the installation of the B-S Viper or the Rolls-Royce R.B.145 in mind as alternative powerplants.

After a thorough briefing on the design and development of the Canadair trainer from tactical aircraft sales director Hedley Everard, I climbed into the left-hand Weber ejection-seat of CF-LTW-X at Frankfurt/Rhein-Main alongside test pilot Ian MacTavish. First impression of the CL-41 is the remarkable roominess of its broad cockpit, accentuated by the remoteness of the sharply raked front screen, which, with the instrument panel, is set far forward.

The rear part of the canopy opens clamshell fashion via an electric jack, and provides excellent cross-visibility from either seat. This overcomes about the only objection that can be offered against side-by-side seating, which has always been popular with the post-War R.A.F., and now seems to be finding favour internationally. The CL-41 offers full duplication of controls and flight instruments for both occupants; the only exception is the undercarriage lever, reached from both seats.

Instrument layout is not yet finalized, but the present arrangement seems satisfactory. Some of the instruments them-

(*Continued on page 333*)

Picture at the top of the page shows the prototype CL-41 jet trainer at the start of its European tour. The inner leading-edge extension is to delay the initiation of compressibility effects.

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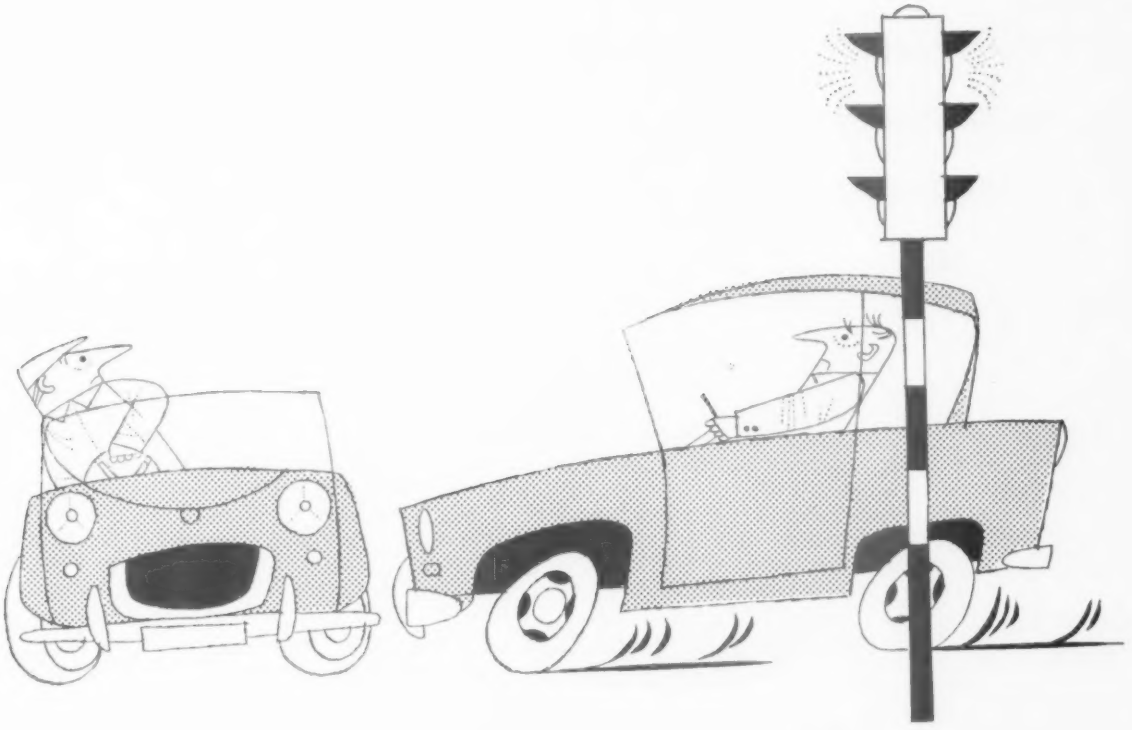

OVERSHOOT – AND HOW TO AVOID IT

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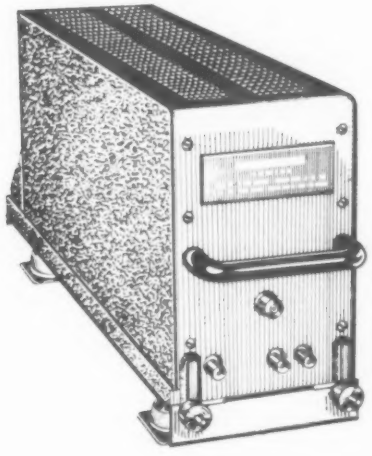

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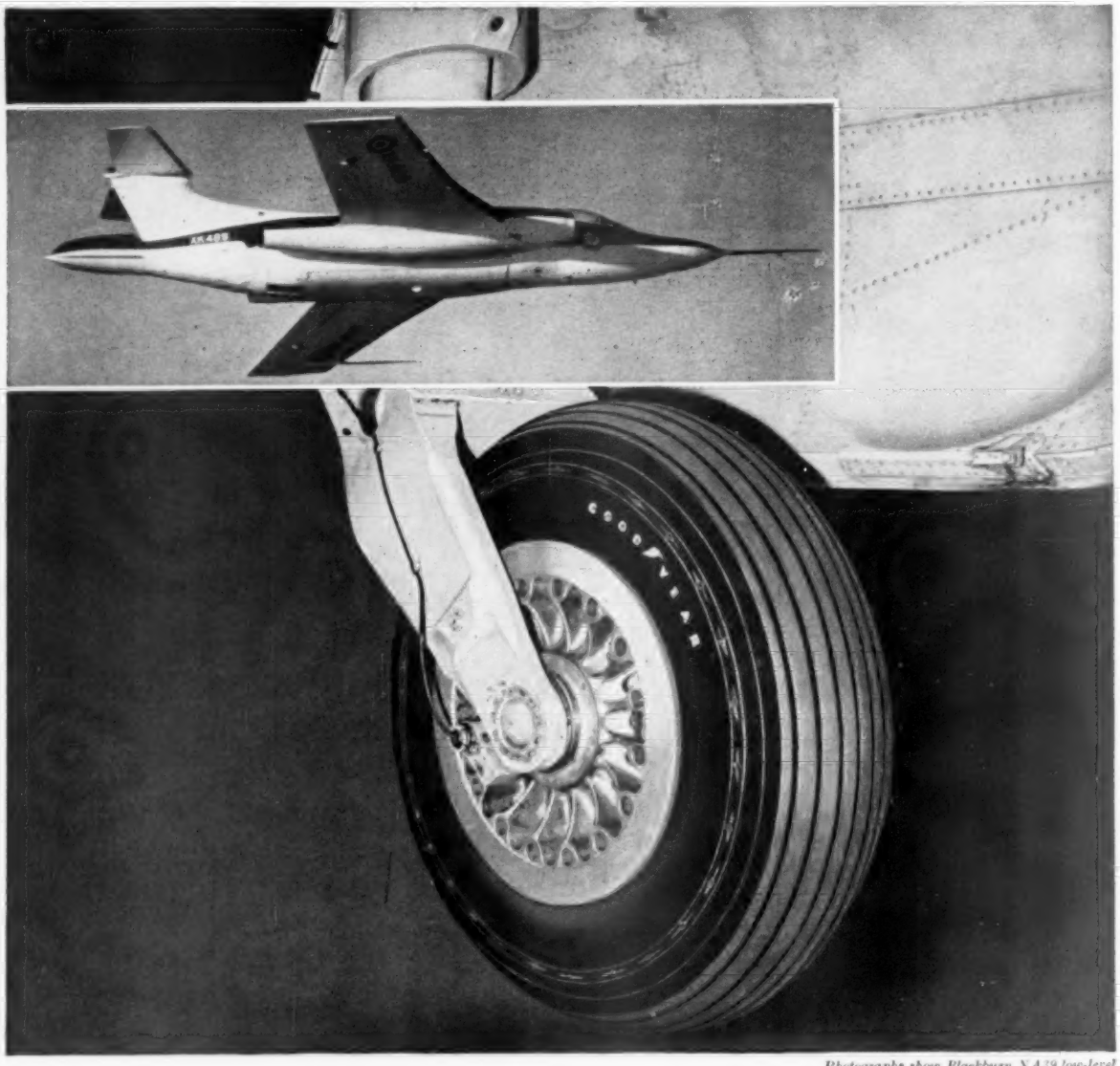

Photographs show Blackburn NA39 low-level strike aircraft, and close-up of wheel assembly. By courtesy of Blackburn Aircraft Limited.

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SERVING AVIATION THE WORLD OVER

(*Continued from page 332*)

selves might be more advanced for F-104 conversion, but whatever changes are made, the layout will continue to include the current annunciator panel. This is a long strip of warning lights providing illuminated legends in conjunction with flashing and clicking master warning and caution bars to give itemized indication of fire, electrical failure or similar dangers.

On a centre console are starting, electrical and radio controls, together with the duplicate throttle and flap levers. Hydraulically operated, the flaps have a three-position quadrant, with 25° and 45° extensions. The dual control columns have the standard U.S.A.F. B8-A handgrips, bristling with switches and selectors, but only the trim thumb button and another little button for nosewheel steering are currently in use. Rudder pedals and toe brakes on each side are suspended to leave a completely clear floor, and are quickly adjustable for leg length.

Back-type P9B-1 parachutes are employed with the Weber seats, which have a two-second harness unlock after ejection. Initial actuation of the side triggers blows off the canopy, which may alternatively be penetrated. It has been jettisoned inadvertently from 10,000 ft. from the prototype CL-41, to which it is still fitted, having been recovered, miraculously, completely undamaged.

Starting the P. & W. J60 could not be simpler. Turning on the master switch also energizes the single booster pump in the collector tank for the five fuel cells, and actuates the low pressure cock. There is no other control or selector for the fuel, which totals 250 Imp. gal. A quick flip of the starter switch initiates the light-up sequence, the only other necessary action being to bring the throttle out of its cut-off detent to idle as the engine is wound up electrically to 10% r.p.m.

Idling setting of 40% gave a comfortable taxi speed for the long, long trail back alongside Frankfurt's 11,800-ft. runway. It also resulted in a slightly stiff finger from holding down the nosewheel steering button which actuates the front leg hydraulically, through 45° each side of centre, according to rudder pedal displacement.

This is the system used by the Sabre and other American fighters and is positive and convenient, if a little elaborate. Its use in the CL-41, which has a turning circle of 37 ft. diameter, is justified on the score of both training experience and the degree of directional control it gives on ice-covered runways compared with differential braking.

The alternative method is available if required, and the hydraulic disc brakes of the CL-41 are quite potent. A smooth ride is conferred by the 11 ft./sec. undercarriage, despite the 135 p.s.i. main tyre pressures. The mainwheels are of very thin section compared with the nosewheel, which has a relatively dumpy 65 p.s.i. tyre. With its 13.2 ft. track, the low-slung CL-41 is very stable on the ground, where its behaviour is typically tractable.

Pre-take-off checks include a blip of the stick switch for neutral elevator trim, indicated by a green strip at the bottom of the annunciator panel, which should otherwise be "clean," and visual observation of centralized aileron trim. The port aileron has a trim surface in addition to a spring tab, while at the moment the starboard aileron has a geared tab. Geared tabs have been tried on both ailerons, but since the present arrangement comes within 0.1 of the required U.S.A.F. rolling criterion of 0.9 radians/sec., with stick forces of less than 25 lb., the final solution will probably be wider span spring tabs on each side.

Aileron and elevator trim control from the stick thumb switch may be overridden in the event of a runaway by individual selectors on the left of the cockpit. Experience with T-33s and Sabres has shown Canadair that most malfunctions occur in the stick circuit, which is subject to constant movement, but the out of trim forces in the CL-41 are never very large.

As the J60 has a completely automatic fuel control, the throttle may be banged open at any speed for take-off, with the engine following briskly from idling to full power in less than six seconds. Ian MacTavish recommended using nosewheel steering for only the first few yards, since it is fairly sensitive, even at low speeds. A jab or two of toe brake is all that is then necessary if the CL-41 starts to wander, until the rudder becomes effective in the region of 50 knots. Acceleration is pleasantly rapid, and slight aft stick pressure at 65 knots starts taking the weight off the nosewheel prior to a more decisive rotation at 85 knots.

It was hot and calm (30° C and 4 knots) at Frankfurt at the time of my flight, but the CL-41 soared skywards with the aid of take-off flap and had a couple of hundred feet by the time we passed the end of the long runway. Leaning on the brakes to stop the wheels spinning, I retracted the gear, but there was no noticeable change of trim until I brought the flap up. The nose then had to be held down a little to maintain the initial climb speed of 180 knots.

There seems to be much less free airspace in central Germany even than in England, and we had to hold the CL-41 down at first to 2,000 ft. until clear of the Frankfurt zone. I throttled back slightly from max. power of 95%, which can, of course, be maintained indefinitely with the derated engine, and we steamed off southwards through the cloudless haze towards Worms.

Photograph copyright "The Aeroplane and Astronautics"

Layout of the roomy cockpit of the prototype CL-41 is not necessarily representative of production aircraft, although few changes are likely to be made. The annunciator strip may be seen in the centre of the panel.

Given clearance to climb, I opened up to full power, and with the excess urge from our cruising speed, we zoomed up to an indicated 5,000 ft./min. ascent for a minute or two, before the climb fell to around a consistent 3,000 ft./min. We were given by control a maximum ceiling of 15,000 ft. which was reached in about five minutes.

The CL-41 takes only 12.3 min. to reach 30,000 ft. and, of course, is pressurized for operation at that height. Pressurization starts at 8,000 ft., where the cabin pressure remains until the maximum differential of 3 p.s.i. is achieved. This is not until about 20,000 ft., so we were very comfortable at our controlled height.

I felt immediately at home in the CL-41. Apart from the comfort of the roomy and air-conditioned cockpit, control response and harmonization felt just right and the J60 was clearly a smooth, willing and obedient source of power. Canadair seem to have gained what they were after with the ailerons, which are crisp and responsive after moderate breakout forces, their only slight lack of positivity being in stick centring. I overcame a slight tendency to over-control laterally within a couple of seconds of becoming airborne, which seems to indicate that the CL-41 should provide a useful introduction to the more potent power controls of operational fighters.

As one would expect, stability was about neutral laterally and just positive longitudinally, while I detected a slight tendency to tailwag in the more turbulent air lower down. It was a rare thrill to get back to a "tigerish" aeroplane after a long spell on the more opulent and sedate American executive types, but the CL-41, despite its willingness to be thrown about, lost very little by comparison in low-speed handling.

I started off at 15,000 ft. with a clean stall, but after throttling back and raising the nose, we soon found ourselves at 16,000. Speed decayed very slowly, but eventually, at about 83 knots on the drum-type sensitive A.S.I., a rattling buffet brought the starboard wing down into a stall.

Because of the T-tail, there is virtually no stall warning, which was also the case in the "all-down" configuration. Flap and undercarriage limit speeds have deliberately been placed at a high 175 knots, to give inexperienced students time to sort things out, and all that was necessary after lowering the full 45° of slotted flap was a blip of aft trim to relieve the nose-down tendency. The all-down stall was almost identical to the first type, except that the speed indicated around 73 knots.

We then had about 1,100 lb. of fuel on board, having started with 200 gal. At Ian MacTavish's suggestion, I continued in a gliding turn with the CL-41, after it was cleaned up, and steepened it from an airspeed of 110 knots until once again a washboard judder and a starboard wing drop indicated its desire to roll out of the bank. It could not have been more gentlemanly.

Next on the programme were spins. The CL-41 has completed its preliminary spin schedule at forward and aft C.G.s, clean, dirty and with pro- and anti-spin aileron. Only with

full aft C.G. and aft trim will it not recover from the spin if left to its own devices. It has completed more-than-20-turn spins from above 30,000 ft., where its entry is of a text-book nature, although lower down it has the typical rough and oscillatory autorotation of most jet aircraft. Its next sequence will be the exploration of inverted spins.

I tried two spins to the right, using full right rudder and hard-back central stick coincident with the clean stall. The CL-41 rolled over to the right quite gently, to the accompaniment of a great deal of buffet, especially on the rudder. On the first occasion, I used insufficient foot load to counteract rudder buffet, and the CL-41 recovered by itself after a turn or so.

A more determined effort got us into a brisk autorotation the second time, at a steep angle and fairly consistent pitch attitude. Opposite rudder and central stick stopped the rapid rotation in about a turn, and recovery from the ensuing dive was gentle. We then found ourselves at about 10,000 ft., having started at 15,000.

I do not often get the opportunity to practise aerobatics, especially in jets, but the CL-41 is very kind to one's diffident attempts. Rolls, of course, are simply a matter of putting the stick over in the required direction at about 200 knots, and only a little more finesse is required for loops. A gentle dive to 270 knots, with firm forward stick pressure against the increasing speed, and then relax to let the CL-41 fly itself round at about 3½-4 *g*, resisting the temptation to pull the suddenly light stick back at the top, where we have about 100 knots; a little more *g* in the ensuing dive, and then lose some of your speed in an effortless upward roll.

In something like a CL-41, and on a day like this, one wonders why pilots get paid for flying.

Plenty of fuel left for a couple of circuits, if control are kind to us (as indeed they have been), so air-brakes out for a let-down, and back to the beacon. Perhaps the only suggestion of disappointment throughout the flight at this point: operating the air-brake switch on the throttle seems to produce no noticeable deceleration, buffet or trim change. They must be working, since we are descending rapidly without exceeding about 250 knots, but Canadair are well aware of this deficiency, and the air-brakes in production CL-41As are to be doubled in effectiveness.

No room for a Mach run on this flight, but the prototype has been up to 0.75 without compressibility troubles, and is currently cleared for 0.7M for demonstrations. The design 0.8M will be achieved as the flutter envelope is extended, with the aid of the R.A.E.'s little rocket "bonkers" in the tail, for excitation.

Back in the circuit, there is no trouble in getting down to flap and gear speeds after throttling back, and then gradually getting slower from the initial 175 knots, to reach about 120 on base leg. Apart from the rather thick windscreen arch, runway visibility is excellent, and low-speed control ample to reduce to 95 knots on finals. Engine response is good to adjust the rate of sink, and with full flap the aim is to arrive at 85 knots for the flare-out.

Elevator is ample at this stage, and the usual tendency, because of the low-slung undercarriage, is to flatten-out fairly high. I conformed to this pattern, but it was just a question of holding the attitude and letting the CL-41 sink obligingly on to its soft oleos. Air brakes were left out, since they are the lateral fuselage type and do not affect control or ground proximity, and the CL-41 can overshoot with everything down plus full aft trim as well. Brakes are effective, and on reaching the end of the roll, nosewheel steering can be engaged for the turn-off.

After more than an hour in the CL-41, I was convinced that it more than meets its specification, and is a sound concept, soundly engineered. If this specification results in an aeroplane that seems supremely easy to handle and is unprecedentedly forgiving, then this is presumably the way that military types are developing. The very high sink rates at low airspeeds of some of the more advanced operational aircraft, however, will need some pre-familiarization, but this will presumably be done at the operational stage in the two-seat adaptations.

With a basic cost of $200,000, in round figures, and relatively low operating expense, the CL-41 should certainly offer an economical prospect for many stages of training, and is thus likely to be of considerable interest to many of the smaller air forces.

Leading Particulars

Dimensions.—Span, 36 ft. 4 in.; length, 32 ft.; height, 9 ft. 4 in.; gross wing area, 220 sq. ft.; track, 13 ft. 2 in.

Weights.—Empty, 4,859 lb.; crew, 400 lb.; fuel (247 gal.), 1,927 lb.; oil, 14 lb.; gross weight, 7,200 lb.; overload gross, 7,650 lb.

Performance.—Max. level speed, sea level, 385 knots; at 30,000 ft., 412 knots; cruising speed, 85% power, 300 knots; initial climb, sea level, 4,100 ft./min.; at 30,000 ft., 1,400 ft./min; service ceiling, 44,500 ft.; stalling speed, 65 knots E.A.S.; take-off to 50 ft., 1,830 ft.; landing from 50 ft., 1,920 ft.; range with 175 lb. reserve fuel, 800 n.m.; endurance, 2 hr. 25 min.; typical training mission, 2 hr.

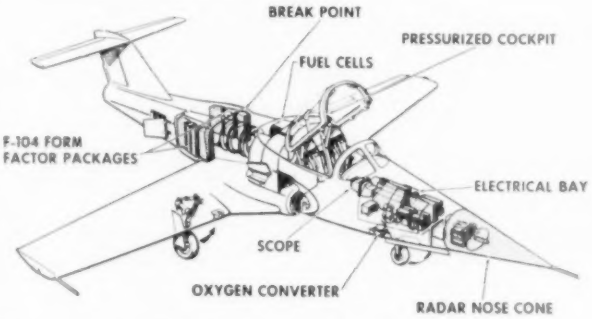
Systems Familiarization for the F-104

THE need for a two-seat trainer with the weapons systems electronics of the F-104G supersonic strike fighter is illustrated by the fact that current flight instruction on the radar equipment is given in a venerable and converted DC-3. It is, of course, possible to use the two-seat F-104F version for this mission, but both initial and operating costs tend to take a large slice of the overall training budget. By using a subsonic systems trainer, for which Canadair have developed the CL-41R, NATO air forces operating the F-104G have the opportunity of effecting substantial economies in aircraft and support requirements without compromising efficiency.

Carrying the same complex electronic equipment as the F-104G and using the characteristically long nose radome, the CL-41R is half the cost of an advanced trainer for a similar rôle, and one-third the cost of a flying classroom type aircraft. Basic airframe cost of the CL-41R has been quoted as around $225,000, or, in round figures, some $500,000 with full electronic packages. In fuel consumption, the CL-41R costs $12.40 an hour, compared with $46 for an advanced trainer and $112 for the F-104F/G. Similarly, a survey of maintenance man-hours per flight hour shows that the CL-41R requires four man-hours compared with 21 for an advanced trainer and 45 hours for the F-104G.

Structural integrity of the CL-41R provides a fatigue life of over 5,000 hours, even when the aircraft is operated continuously at altitudes below 500 ft. The small trainer can operate within a large spectrum of the F-104 mission capability, having manœuvring load factors comparable with operational aircraft and providing economical instruction in inertial navigation as well as pilot-proficiency checks at squadron level. The CL-41 can use small airfields; it has side-by-side seating with a central radar scope; and has self-contained facilities for engine starting and warm-up of electronic equipment.

Equipment common with the F-104G comprises NASARR Model R24A radar system, nose radome and pitot-static boom; inertial navigation system LN-3; UHF radio ARC-552/AIC-18; TACAN; selective identification feature; air data computer; UHF



communications antenna system; and standard form factor packages (carried in rear-fuselage bulges) of F-104 electronic equipment. The NASARR monopulse radar system performs the functions of air-to-air search, air-to-air blind acquisition and automatic tracking; ground mapping, contour mapping, terrain avoidance and air-to-ground slant ranging.

The CL-41R advanced systems trainer has a similar performance to the 475-m.p.h. CL-41A, although its gross weight is increased from 7,200 lb. to 7,870 lb. If required, improved performance is available by the use of the full 3,000-lb. military thrust rating of the Pratt & Whitney JT-12 turbojet. This gives the CL-41R a maximum level speed of 512 m.p.h. at 20,000 ft., reduces the time to 20,000 ft. to 6 min. and increases the sea level climb to 4,700 ft./min.

Length of the CL-41R is 40 ft. 7 in. Limiting load factors are +5.3 and −2.1 *g*, and maximum Mach number, 0.8.

Development of the new version of the CL-41, which is being studied with interest by the Canadian and German Governments, among others, is a logical step for Canadair. The basic CL-41A has reached an advanced stage of development, and the first Canadair-built CF-104 was rolled out on Mar. 27. Two hundred CF-104s are on order for the R.C.A.F. in Europe, and Canadair is building many other Starfighters in the form of knock-down components for NATO and export production.

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Research such as this is essential to the development of an economic fuel for supersonic flight.

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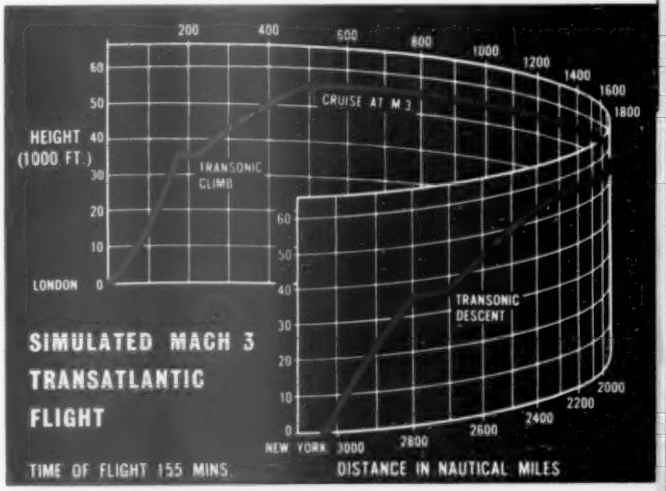

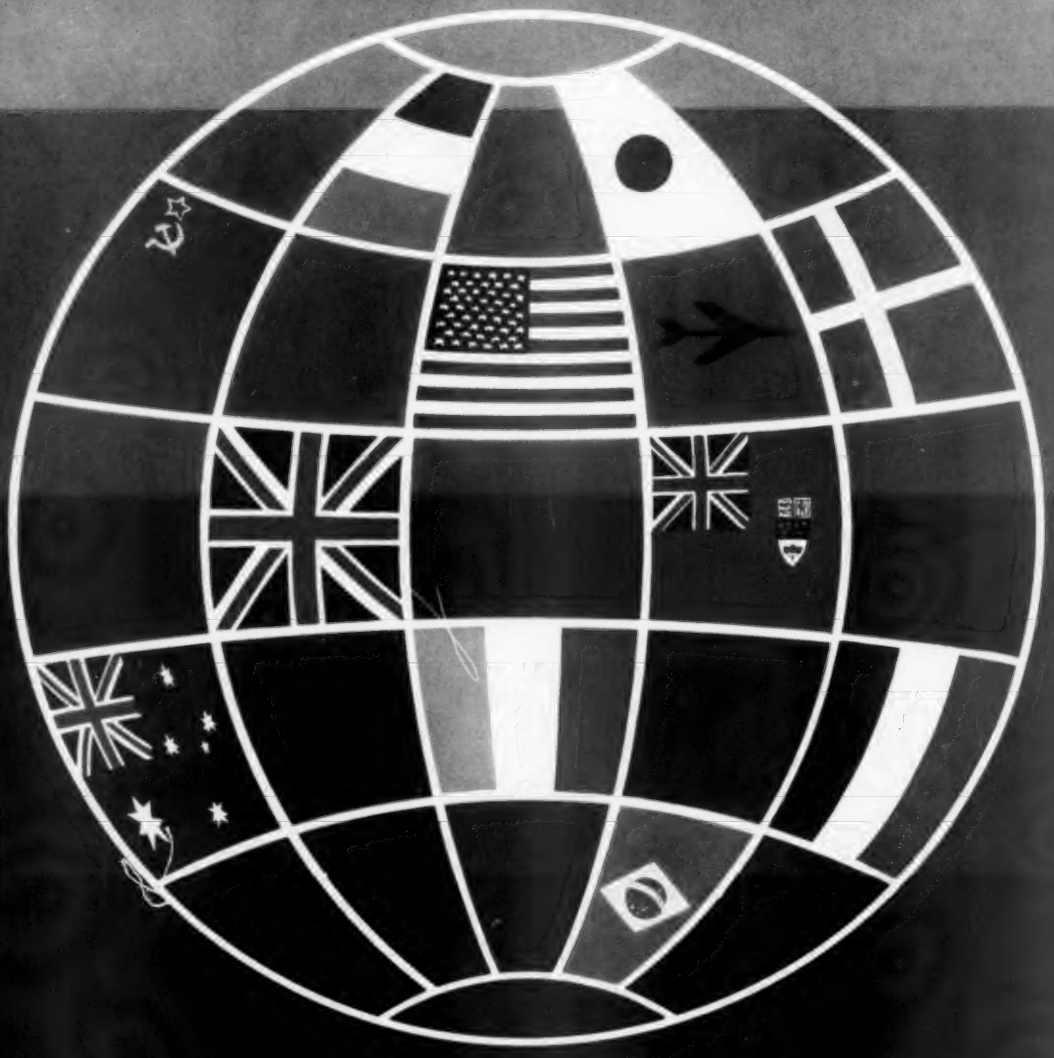

FRANCE: SA Caravelle Breguet 1150 Atlantic Transall C160 Mirage 3
SWEDEN: SAAB Lansen SAAB Draken ITALY: Fiat G91T JAPAN: Namco YS11
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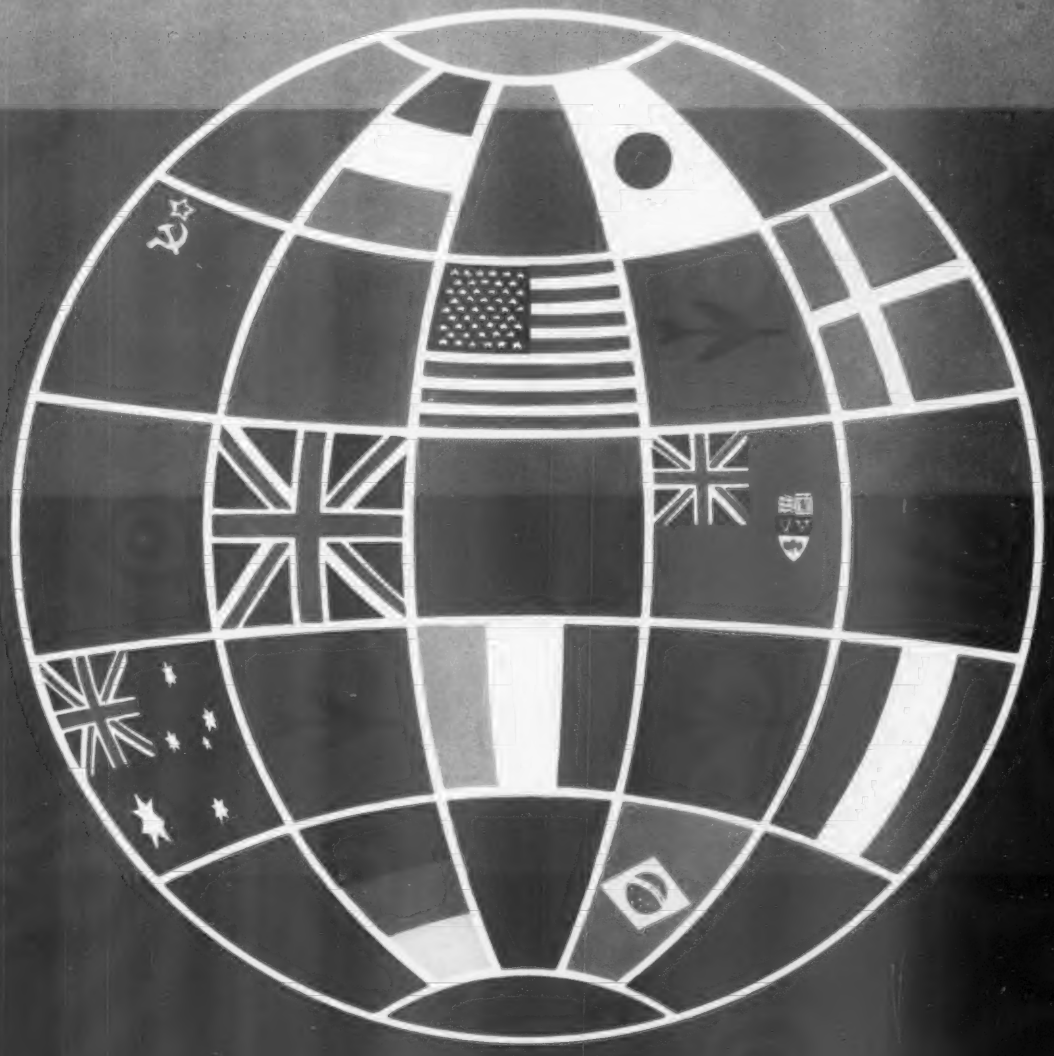

FRANCE: SA Caravelle Breguet 1150 Atlantic Transall C160
SWEDEN: SAAB Lansen SAAB Draken ITALY: Fiat G91T Macchi MB326
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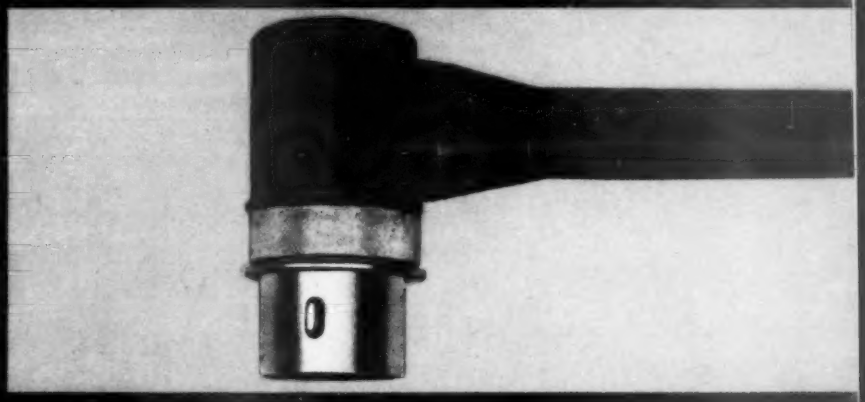

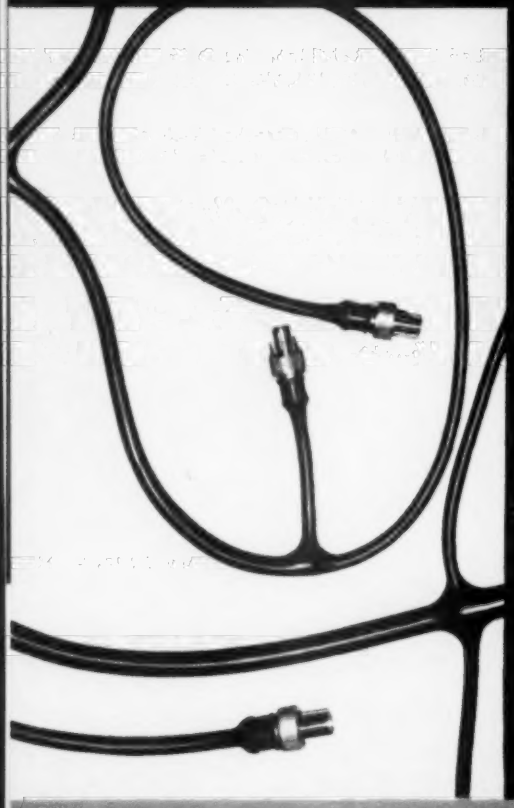

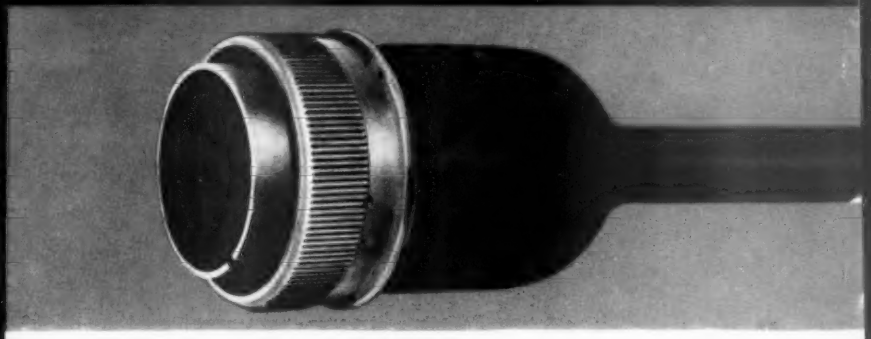

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Getting the Feel of Jet Lift

by John Fricker

SHORT's SC.1 flat-riser, from its many demonstrations at Farnborough, Paris and elsewhere, has made jet VTOL and level-flight transitions almost commonplace and yet, up to the present time, no other aircraft in the World has shown itself capable of successfully duplicating this achievement as a matter of routine. It will probably be only a matter of days before this situation is changed—but this will not alter the fact that, with the SC.1, Short Bros. and Harland have a unique background of VTOL jet experience, dating from the first cautious hovering trials in October, 1958.

To be precise, practical experience started even before this time for both pilots and technicians concerned with SC.1 development, who were able to experiment with the operation and effect of the aircraft's air nozzle control and autostabilization systems under realistic and dynamic conditions. This was made possible by the construction of a full-size simulator rig, pivoting freely on a central air bearing, and accommodating all the hydraulic and electric control and autostabilization services, transistor mechanisms and pilot's equipment and instrumentation of the actual aircraft.

A cruciform steel structure representing the fuselage and mainplanes of the SC.1 was built to have a similar inertia to the actual aircraft, although, in the case of the dynamic rig, its jet engines to supply the necessary air source were mounted outside the simulator enclosure. Pressure air was tapped from the compressor of a centrifugal Nene turbojet of the type fitted to the Rolls-Royce "Flying Bedstead," but, as this tends to surge at high r.p.m., an axial-flow Avon, designed for flap-blowing in the Supermarine 535, is also available.

Ducting and air-jet control systems are the same as in the SC.1, hot pressure air being fed from the engine room through the centre pivot to a distributor head on the rig. It is then ducted to the variable-area control nozzles in the wing-tips, tail and nose, which provide stability and adjustment of aircraft attitude in the hover condition. To avoid adverse ground effects in the simulator, these nozzles are inverted to exhaust upwards, compensation being made by incorporating reverse links in the control circuit and correcting the autostabilizing mechanism.

Aileron and elevator control surfaces, which naturally move with stick displacement, are simulated by torsion bars and masses, representing load and inertia respectively. The rudder is not thus represented, although directional jet control is faithfully reproduced by differential rotation of the fore and aft nozzles.

In its completed form, the simulator offers many advantages, although kept relatively simple with no linked computer. Not only did it enable the original SC.1 test pilot, Tom Brooke-Smith, to become familiar with the control response and characteristics of the aircraft in the hover regime, but it was also used for the functional testing of the hydraulic autostabilizer, elevator power control and air nozzle systems with both safety and accessibility. It eliminated the need for a separate test rig for each system, and facilitated the use of recording instruments in a separate control room connected to the rig by overhead cables. It is also possible to operate the rig remotely from this room, either manually or by signals fed from a Short analogue computer.

Yet another application was the simulation of emergencies—particularly the failure of one of the SC.1's four vertical lift engines. This is achieved by moving a mass on the simulator to give an out-of-balance moment equal to the displacement of the vertical-jet thrust centre and, at the same time, closing one of the ports in the air distributor head to reduce the flow. Some of the high-pressure air from the Nene or Avon is ducted to the central semi-spherical bearing, to provide a cushion which is virtually frictionless.

Armed with this essential minimum of background, I approached with some interest, during a recent visit, the fearsome-looking rig which is tucked away behind corrugated-iron walls in a remote corner of Queen's Island airfield, Belfast. It was explained to me that as the simulator was necessarily fixed-base and with no variation of "hover" height, the pilot's controls were confined to stick and rudder pedals for three-dimensional alteration of attitude. Using helicopter parlance, the cockpit was equipped for cyclic, but not collective, control, and the rig does not, of course, introduce any related effects of translational movement following tilting of the lift vector by a change in aircraft attitude.

Handling the simulator is therefore very much easier than hovering the SC.1, but, with the aid of a rectangular sight mounted above the rudimentary instrument panel and a convenient graticule on one portion of the circular wall, control response and autostabilization effects can be explored with precision. The SC.1 uses a triplicated-channel system for its

fully-powered pitch and roll controls, so that, in the event of a failure in any part of the circuit, or a runaway, two channels remain at the disposal of the pilot. Each channel is completely separate and may be isolated by selector switches in the cockpit for functional checks.

From the stick, position signals are fed into an amplifier box, together with the output from the six rate gyros and the three two-axis attitude gyros. The amplified and modulated signals then go to the servo motors, which again are triplicated for each control. Each is capable of supplying 100% power for control actuation. The attitude gyros were not installed in the simulator at the time of my "flight," which meant that the rig was only autostabilized in pitch and roll. It seems that the effects of this are not particularly apparent to the uninitiated pilot.

Settled in the lofty "cockpit" of the rig, and in RT contact with the surrounding earmuffed technicians, I heard the distant wail of the Avon starting up against a busy background growl of electrics and the hydraulic motor. My first essay into jet-lift hover was to be in the manual mode, for reduced sensitivity, and, after the access ladder had been taken away, I heard the drill being run through for withdrawing the hydraulic stops and leaving the two-ton rig suspended on its air bearing.

Gusts of warm air, together with a thunderous roar of jet blast, announced the arrival of our control medium and the stick came sluggishly to life. Heavy loads and a fairly wide range of movement seemed characteristic in this mode, but instability did not seem over-pronounced—possibly because of the greater resistance of the rig to external disturbances through its mechanical limitations. It did not seem too difficult to keep the sights in fairly motionless alignment in the simulated hover, and equilibrium could be restored fairly quickly after a violent change of attitude (an unseen heave, I gathered, on one of the rig's extremities). In some cases, however, full control travel was necessary to compensate for the change in attitude, with the stick on its stops.

To the accompaniment of rich Irish brogues on the RT, the Mk. 1 auto stabilizer was changed to "auto" operation, and the difference in handling was immediately apparent. On centring the stick, greatly reduced loads were evident, and the necessary range of movement to maintain a constant attitude was very much smaller. Control via the air jets felt to me to be surprisingly crisp, and corresponding quite closely to the feel of normal control surfaces in forward flight. As the rig is restricted, because of its structure, to a 10-degree change of attitude in pitch and roll, the effects of air nozzle control could most easily be explored in yaw, which allows 180 degrees of movement.

The sort of rates of yaw which I explored by vigorous rudder pedal deflection would hardly be necessary, or perhaps practical, in the SC.1 itself, but on the rig they did enable the power and precision of air-jet control to be experienced. A rapid yaw could be initiated and stopped with precise control at any given point after very little experience. In "auto" the only tendency to over-control seemed to be laterally, where a slight wobble could be encountered while endeavouring to centre the stick.

Brief experience with the simulator, however, left me with an even deeper respect for the one or two pilots who have flown the SC.1, with its many added factors of disturbance and additional complication of height control through variations of jet lift. After the success they have achieved, the way is open for more practical development of the proven capabilities of the multi-engined jet-lift VTOL concept, and a tactical application would seem desirable as a parallel to other lines of similar experiment.

The "cluster" concept of lift engines has been thoroughly proven in practice by the SC.1, and its particular suitability for supersonic flight makes it worthy of a more advanced research programme. With the improved specific weights obtainable from later lift engines, aircraft of the "cluster" configuration will be able to offer worth-while payloads while still achieving vertical take-off, avoiding the limitations of even V/STOL performance currently thought to be acceptable with other types of jet lift. A final, and very significant thought is that, whereas the next Short VTOL project, should it materialize, will be a second-generation aircraft, everyone else's will be a first attempt.

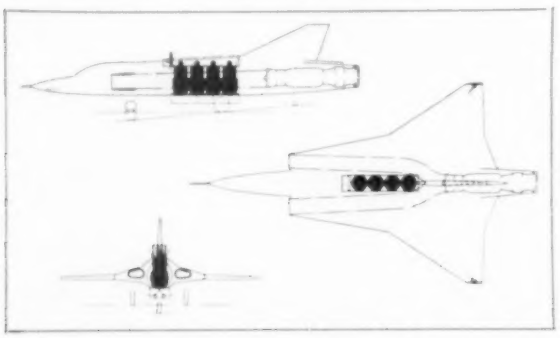
Powerplants for VTOL

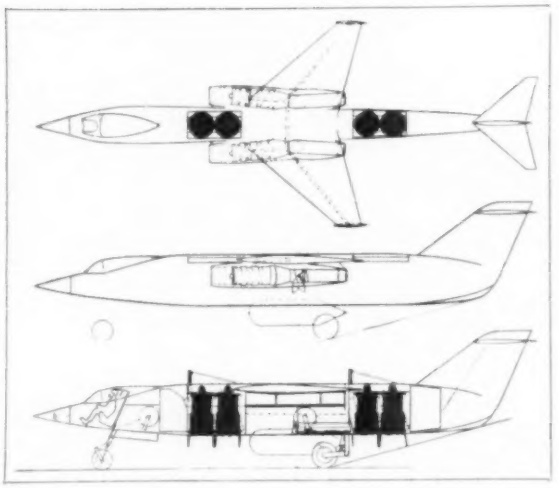
AS we have noted elsewhere in this issue, once again at Farnborough there is a good deal of emphasis on special powerplants suitable for the coming generations of VTOL aircraft. On the Rolls-Royce stand, in particular, there are to be found some interesting models of hypothetical projects embodying vertical lift engines.

These studies have, in fact, been dealt with in greater detail in a paper—by Mr. G. L. Wilde, A.F.R.Ae.S., head of the company's preliminary design section—that was disclosed just before the Show opened. In it, Mr. Wilde states categorically that two types of VTOL aircraft can be developed in the immediate future. All the engineering problems of their powerplants can be solved, he says, using data which is now available or the results of current tests and research. Four project studies—two fighters and two transports—are discussed.

One of the types is a short/medium-range strike aircraft, to cruise at high subsonic speed at sea level, carrying a military load equal to about 10% of its all-up weight. Supersonic performance at altitude could be provided, if required, with reheat on the propulsion engine.

The other type, which could have either VTOL or STOL capability, would be a tactical transport aircraft of about 100,000 lb. take-off weight. It would carry a payload of 20,000-30,000 lb. for ranges of about 500 n. miles, cruising at speeds of 300-400 kt. at heights up to 20,000 ft.





As seen in the accompanying drawings, all these are of basically conventional layout. They follow well-established aerodynamic design and offer no new design problems.

Mr. Wilde considers that the overall risk involved in choosing a completely unconventional layout appears to be too great at the present stage. Nevertheless, he says, the engine designer still looks hopefully for an elegant design of V/STOL transport aircraft; he continues to achieve lower engine and powerplant weights, confident that a really good aircraft configuration will finally emerge. It is now possible to design a jet-lift engine which gives a thrust up to 16 times its own weight.

The first of the two types of VTOL strike aircraft illustrated has a cranked delta layout and four lift engines in the centre with a single, "efficient," by-pass engine for propulsion. The second type has a wing of higher aspect ratio; four lift engines

(*Continued on page 337*)

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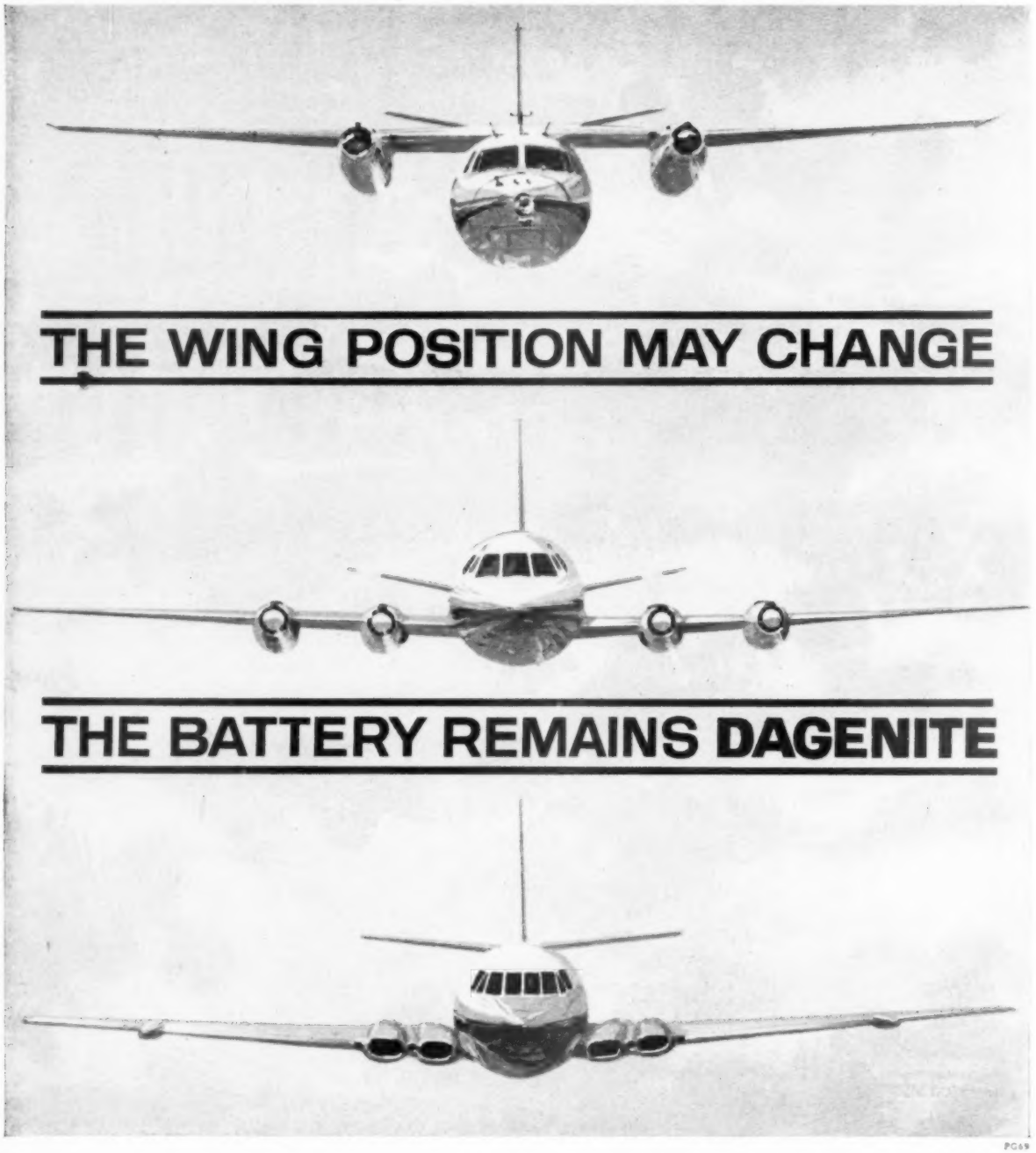
(Continued on page 537)



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(*Continued from page 336*)

are installed in two pairs at the front and rear of a central weapons bay, and two pure-jet engines for propulsion are installed in the wing roots.

Both aircraft would be stabilized during hover and transition by control jets in the wing tips and fuselage fed by compressed air from the lift engines. Thrust of the control jets would be regulated by an autostabilizer.

The cranked-delta type is really a refinement of the SC.1 design, with lighter lift engines and a much more efficient propulsion engine.

Although the second configuration is new, Mr. Wilde suggests that the layout presents no great difficulties. The pitching moment resulting from an engine failure would be greater than with the cranked-delta type, and a greater installed lift-thrust/weight ratio would be needed. The two pure-jet propulsion engines would be lighter than the by-pass engine of the other aircraft, but this would be offset by their higher fuel consumption.

It is often claimed, says Mr. Wilde, that there will be a big saving in installed thrust, if such aircraft are designed for STOL, rather than VTOL, performance. This depends on the definition of STOL adopted; if it is taken to mean attainment of a height of 50 ft. in a horizontal distance of 500 ft., the thrust/weight ratio needed is 1.05.

For STOL performance of this type it is necessary to deflect the thrust during the take-off at low forward speed, and the aircraft aerodynamic controls will not provide sufficient pitch and roll control for safe operation.

It is much better to design the aircraft from the start for VTOL operation; to ensure satisfactory manœuvrability during vertical take-off and landing, a thrust/weight ratio of 1.2 is necessary. Installed thrust is not a great deal more than for the STOL type, and if the aircraft is designed at the outset for VTOL operation, its take-off and landing will be safer than with the STOL type. The author makes the further point that whereas a VTOL aircraft can achieve STOL, the reverse is not the case.

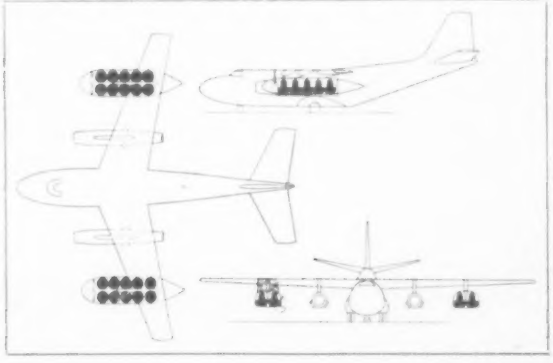
If a definite requirement is stated for an STOL strike aircraft, a choice must be made between the use of a single engine whose propulsive thrust can be deflected to give lift thrust, or a composite powerplant with separate propulsion and booster engines, all of which have means of thrust deflection. In both cases a thrust/weight ratio of 1.05 is needed.

If a single-engined layout is chosen, the powerplant design must be a compromise between take-off and cruise requirements. It will have too high a thrust for the subsonic cruise and must be designed with a medium pressure ratio, to keep the specific weight low, and with a high by-pass ratio to reduce fuel consumption. The engine must be well throttled back for cruise, giving a poor specific fuel consumption at high subsonic speeds.

If the composite powerplant is chosen, separate propulsion and "booster" engines are used whose effluxes can be deflected during take-off. Both types of engine can be designed for the best performance in their respective rôles without the need for any compromise. This means that the lightest possible turbojet booster engine can be combined with a propulsion engine or engines whose thrust is matched to the cruise or manœuvre requirements.

Comparison of aircraft of these two types, designed to meet the same low-level strike rôle, shows that the one with composite powerplant will be much smaller than the single-engined aircraft, particularly if the composite type has a by-pass propulsion engine giving a good specific fuel consumption. In this case, the single-engined aircraft will have a take-off weight more than double that of the composite powerplant type.

At the economic cruise speed of Mach 0.45 the single engine is throttled to 12% of maximum thrust, whereas with the composite type the propulsion engines would be throttled to about 20% of the maximum rating. In these conditions the single engine has a very much higher fuel consumption.

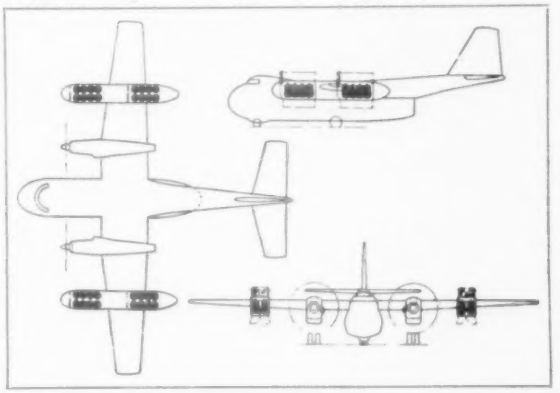


In estimating the weight of a VTOL aircraft for the low-level strike mission, a delta planform of low aspect ratio was chosen. High-lift devices are unnecessary and were omitted, and a lightweight undercarriage was assumed. This led to the assumption that a structure weight of 18-20% of the take-off weight was possible, compared with 28-30% for the STOL aircraft.

The conclusion from these Rolls-Royce studies is that sufficient booster or lift thrust can be installed to achieve vertical take-off and landing without the need for deflection of the propulsive thrust, and that a VTOL aircraft of this type need only be very little heavier than a STOL aircraft with a composite powerplant which has been designed for the same mission.

The tactical transport studies illustrated in Mr. Wilde's paper are, he says, by no means an ideal solution; but, nevertheless, "they are a practical step towards the large VTOL transport." This aircraft is of conventional layout, with the addition of pods on the wing which carry lift engines. In one case they are pure jet lift engines, in the other case, lift fans. The aircraft with fan-lift engines has thrust deflectors on its propulsion engines.

An arrangement of this type offers little scope for the reduction of structure weight, and VTOL capability brings with it severe range and payload penalties. But such an aircraft would be very useful for gaining operational experience, and would allow the multiple-lift-engine powerplant and systems to be developed in readiness for later aircraft of more advanced design.



With such an aircraft it is unlikely to be practical to deflect all the thrust for STOL operation as is possible for a small strike aircraft. If STOL of the 500-ft. run to 50-ft. height variety is needed, it would be better to design from the start for VTOL operation. In this case, studies show that the lift-thrust/weight ratio should be 1.4 to 1.45 if the aircraft is to be capable of operating in ISA+20° C. conditions from an airfield 2,000 ft. above sea level.

On the general subject of VTOL powerplants, Mr. Wilde points out that the ratio of lift-thrust to aircraft all-up weight will depend on the configuration of an aircraft and its operational environment. The size or number of lift engines is decided by matching the maximum engine take-off rating to the hottest and highest operational conditions likely to be met.

At its maximum rating, a lift engine would have an overhaul life of about 200 hours. Assuming one-hour sorties and that only 20% of the take-offs will be at the full design rating at 100° F. and 2,000 ft. with the rest at ISA sea level, and with landings at 80% of the take-off weight, this would give a lift-engine overhaul life of about 800 hr., which is equivalent to 16,000 airframe hr.

A lift engine must have good starting characteristics, a low idling speed, fast acceleration times and a rapid thrust response to a sudden change in fuel flow. Most of these requirements are met by the RB.108. Although this engine could be developed to give a thrust of 3,000 lb. and a thrust/weight ratio of 10, experience has shown that it is now possible to design a much lighter, cheaper and more simple jet-lift engine. By using the latest materials and manufacturing techniques, the cost per unit thrust can be reduced to less than half that of a propulsion engine of the same thrust.

Small turbojet lift engines of 3,000-5,000 lb. thrust appear to be the most suitable for small military VTOL aircraft. But for large freight aircraft turbofan lift engines of 8,000-12,000 lb. thrust would seem preferable, largely because they produce less jet noise. But engines of this type have a lower thrust-response rate, which affects aircraft control. They also suffer from a relatively high thrust penalty if they are designed to supply high-pressure control jets.

A "Space Dust" Satellite

AFTER radiation, probably the greatest environmental hazard affecting the future astronaut are the dust particles which exist in space. Composed of iron, silicates and other substances, they intersect the Earth's orbit, sporadically and in showers, and although most of them are no larger than grains of sand, they travel at extremely high velocities—from 7 to 45 miles/sec.

The main source of these particles is the asteroid belt, which may be the remains of an unformed planet or one which destroyed itself at an early stage of its evolution. Most of the "debris" is confined to the region of space between Mars and Jupiter, but some particles in eccentric orbits periodically cross the Earth's path and impact on the Earth and the Moon.

When in space, the particles are known as micrometeoroids. Upon entering the Earth's atmosphere and vaporizing, they become meteors, or "shooting stars," while those which reach the surface are termed meteorites. The larger varieties which may occasionally be picked up on the ground are, of course, far removed from "space dust," but fortunately for the space-traveller, they are comparatively rare.

To investigate the micrometeoroids more fully, NASA has a well-defined programme of experiments employing different techniques. A system of some novelty is the S-55 satellite in which the attempt is made to assess the penetrative energy of the dust particles.

A first attempt to launch an S-55 satellite into orbit failed on Jne. 30 when a four-stage, all-solid Scout rocket was fired from Wallops Island, Virginia. Unfortunately, on that occasion, the third stage failed to ignite and the payload was lost in the Atlantic Ocean some 325 miles down range. A second firing on Aug. 25, however, succeeded in placing a similar payload in orbit under the name of Explorer XIII.

Orbital Parameters

The S-55 satellite—which is about 76 in. long by about 24 in. diameter—is installed around the 18 in. diameter Altair rocket motor forming Scout's final stage. A thin stainless-steel heat shield protects the payload during ascent and is subsequently jettisoned at about 344,000 ft. to expose five types of detectors. Launching is made in an easterly direction so that injection into orbit occurs some 1,060 miles down range fom Wallops Island about eight minutes after lift-off.

On its first swing, the satellite was expected to cross the southern portion of Africa, mid-Australia, and the southern region of the Hawaiian Islands. It was then to pass over the central regions of the continental United States, beginning north of San Diego, Calif., before it reached the Atlantic Ocean just south of the launching site. The planned orbit had an apogee of 610 miles and a perigee of 280 miles, with an initial period of about 99 minutes. Figures actually achieved were apogee 606.34 miles, perigee 174.6 miles and period 97.27 min. The launching angle was inclined at 36.42° to the equator.

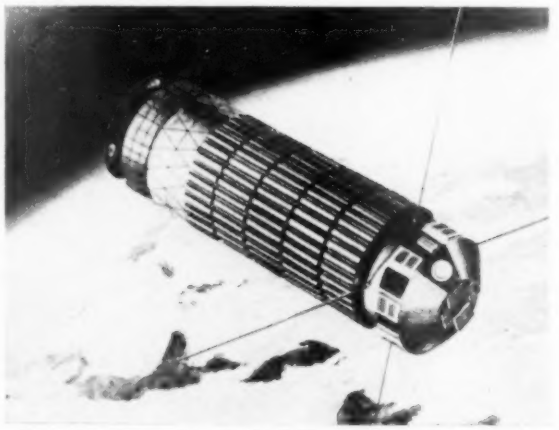
In this particular satellite, the experimental payload does not separate but remains attached to the fourth stage of the carrier rocket. Total satellite weight is 187 lb. Of this, the various sensors, telemetering equipment, and attachment fittings, etc., amount to approximately 125 lb. The empty fourth stage motor and the upper transition section, joining the fourth stage to the third, weigh about 50 lb. and 12 lb. respectively.

At the same time as the protective nose-shield is jettisoned (at the end of the coasting phase following second-stage burn-out), the folded antennae in the satellite's nose are extended. This is immediately followed by third-stage ignition and separation of the second stage. Stage three burns out at an altitude of some 516,000 ft., but remains attached to the fourth stage to provide guidance and control during the period when the vehicle is coasting to the peak of the ascent trajectory at nearly 280 miles.

Finally, the fourth stage is spun-up to about 190 r.p.m. by small rockets and fired from the final stage to attain the desired orbital velocity. The time from lift-off to injection is 8 minutes 18 seconds.

Pressurized Cells

The S-55 satellite is designed to yield information on the impacts of larger sizes of meteoroids than those covered by earlier satellites. Three sensing instruments—pressurized cells, foil gauges, and wire grids—providing a total area of 24½ sq. ft., are exposed to particle penetration. Cadmium-sulphide cells and impact sensors, having a combined total area of 4½ sq. ft., are exposed for impact detection.



An artist's impression of the S-55 micrometeoroid satellite which was successfully placed in orbit by a four-stage Scout rocket on Aug. 25. It is designed to count and measure dust particles in space.

Five test groups of silicon-cells fitted on the nose of the satellite are intended to determine the amount of protection which solar cells will require when operating on protracted space missions. Five cells are shingled for each group. Two groups are unprotected, two groups have 0.006 in. glass sides covering the sensitive area, and one group has a 0.062-in. quartz window.

The primary micrometeoroid detectors are pressurized cells, comprising 160 half cylinders of beryllium copper ranging in

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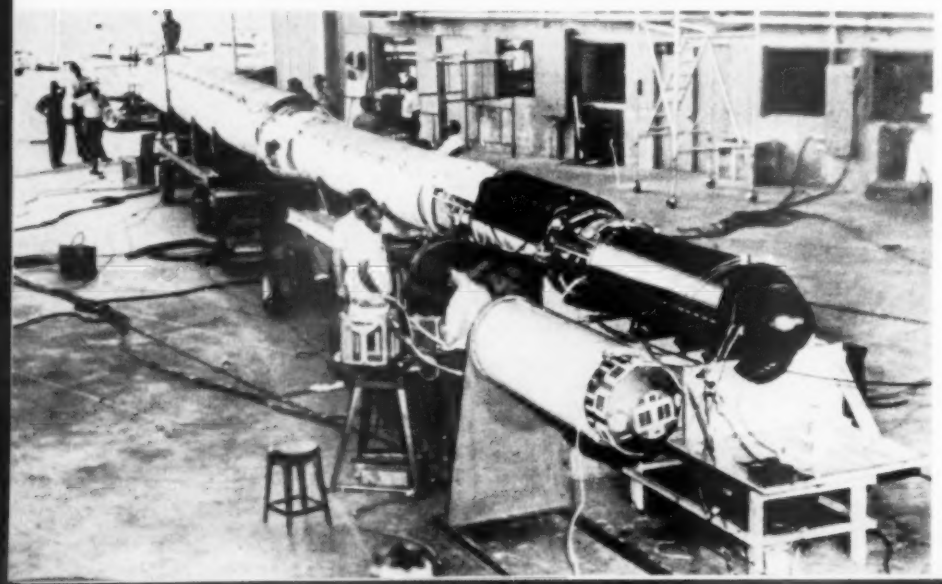

Technicians at the Langley Research Center carry out instrumentation and control tests on the Scout rocket, which was the sixth in the development programme. Apart from placing the S-55 payload (foreground) in orbit, the recent firing gave NASA another opportunity to study the "performance, structural integrity and environmental working" of the 72 ft. long, 36,600 lb. solid booster.

AIR TRAFFIC CONTROL

Television can present tabulated flight progress information instantaneously wherever it is required in an air traffic control centre.

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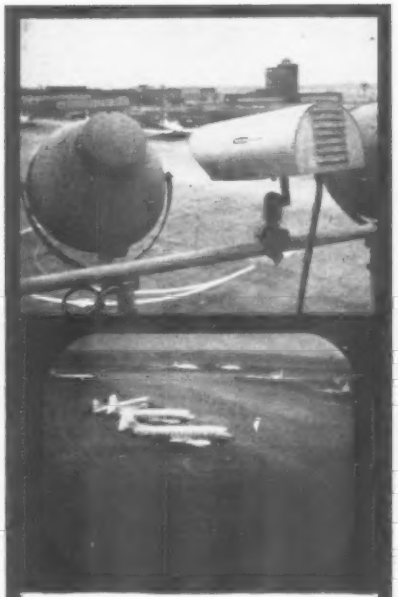

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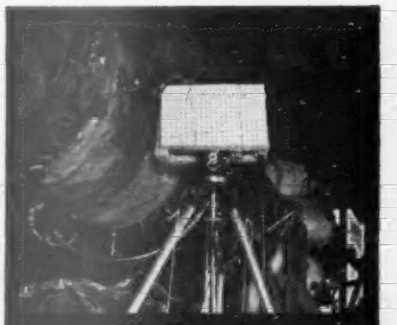

RESEARCH

Observation of after burning in a gas turbine engine at a government research station. This is typical of the many research applications for which television is being used to-day.

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SCOUT 6 LAUNCHING SEQUENCE

Time in seconds	Events
.0	First stage ignites
41	First stage burns out
76	Second stage ignites; third stage heat shield released, and first stage separated
116	Second stage burns out
139	Fourth stage heat shield released; payload antennae erected
140	Third stage ignites; second stage separated
180	Third stage burns out
455	Spin motor ignites
457	Fourth stage ignites third stage separated
498	Fourth stage burns out; S-55 satellite injected into orbit

(*Continued from page 338*)

thickness from 0.001 in. to 0.005 in. Each of the half cylinders has a 2-in.-wide flat area and is 7.5 in. long; they are mounted in five rows of 32 cells each around the circular exterior of the Altair rocket motor. The pressurized cells occupy a 38-in.-long section of the peripheral space in the centre of the satellite.

The exposed cells are pressurized with nitrogen and helium so that puncture by a dust particle will allow gas to leak out. By means of a pressure activated switch in the end of each cell, the pressure loss will be detected and telemetered at the proper time to ground receiving stations. The cells have an exposed area of about 17.25 sq. ft. This part of the equipment, which has been designed and built by the Langley Research Center, is expected to provide information on the ability of certain thicknesses of metal to resist penetration by micrometeoroids.

Installed around the forward half of the fourth-stage transition section are 60 foil-gauge detectors, each in the shape of an equilateral triangle with a 4.57-in. base. Developed by the Lewis Research Center and built by the Buckbee Mears Company, each detector consists of a circuit obtained by an electrochemical deposition process about 90 micro inches thick. This is attached to 0.001-in. Mylar plastic and mounted on the underside of 304 stainless steel skin samples; 48 of these samples are 0.003 in. thick and 12 are 0.006 in. thick.

Micrometeoroids which penetrate the stainless steel "skins" and break the foil circuits will cause a change in the resistance level, thereby recording basic information which can be later telemetered to the ground. The total area exposed to penetration in this instance is 3.75 sq. ft.

The wire-grid detectors, developed by the Goddard Space Flight Center, are similar to sensors which have been incorporated in earlier satellites. The 46 units consist of a winding of fine copper wire mounted to 1.45 in. by 7 in. rectangular melamine cards. Fourteen of the cards are wound with 0.002-in wire and 32 cards with 0.003-in. wire, providing a total exposed area of 3.25 sq. ft.

As cosmic particles strike the grids and break the wound wire at any location, the resultant change in resistance recorded for subsequent transmission will provide another indication of the penetration frequency. The wire-grids occupy the aft portion of the fourth-stage intersection structure.

The fourth experiment, that of the cadmium-sulphide cells, has also been developed by the Goddard Space Flight Center. Two detectors are mounted in the nose of the satellite about 180° apart. Each unit consists of a cadmium-sulphide cell mounted in an aluminized glass flask. The six square inches of exposed surface provided by the two detectors are covered with a sheet of 0.00025-in. Mylar coated with evaporated aluminium on both sides. In orbit, extremely small particles striking the ultra-sensitive detector will penetrate the Mylar film and allow light to focus on the cadmium-sulphide cell, changing its resistance, and permitting it to record information on the size of impacting micrometeoroids.

The last group of S-55 experiments consists of impact detectors. Piezoelectric crystal impact detecting transducers, acoustically isolated from the satellite structure, are fitted to sounding boards located on the satellite's nosing, with others mounted on the pressurized cell area amidships. They provide a total exposed area of 3.75 sq. ft.

Three levels of impact detecting sensitivity are employed. The sounding board portion of the satellite has the capability of recognizing micrometeoroid impacts of two different velocity levels as an aid to the identification of particles of different masses. It is felt that correlation of the cumulative number of impacts of each momentum level with the number of penetrations of the various materials in the pressure cell area may provide the possibility of identifying particle masses by methods of statistical data analysis. Similarly, the pressure cell transducer portion of the satellite is sensitive to micrometeoroid impacts at a certain level.

An additional expectation from this portion of the experiment is that the lower momentum sensitivity level employed may afford some correlation between this type of experiment and the pressurized cell experiment.

Lastly, a series of temperature measurement is taken throughout the satellite at selected points.

Electronics equipment embodied in the S-55 satellite has two functions, first to act as a radio beacon for purposes of ground tracking, and second to provide for the telemetering of information from the satellite.

The radio beacon has been designed to transmit signals until its batteries are exhausted. Two telemeters, working independently to enhance reliability, are used for storing and telemetering data; they have separate solar cells and batteries. To conserve battery power, the telemetering equipment is turned on at prescribed intervals on command from ground stations and after one minute of data transmission this is turned off by an electronic timer pending receipt of the next transmission command.

Communication with the satellite is carried out on two frequencies: 136.860 Mc/s. and 136.200 Mc/s. During the first two weeks, the satellite was being interrogated once per orbit by the Minitrack network in North and South America.—K.W.G.

Technical Data

S-55 satellite weight summary: Nose cone, including sounding boards, power solar cell trays, test solar cell trays, heat transfer ring, antennæ, cadmium-sulphide cells, mounting brackets, and wiring, 27.57 lb.; bulkhead assembly, including telemeter system, batteries, mounting brackets, plugs and wiring, 33.93 lb.; pressurized cells, including mountings, plugs and wiring, 46.93 lb.; grid detectors, including mountings, 4.78 lb.; gauge detectors, including mountings, 6.50 lb.; payload support, 4.37 lb.; heat shield bumper ring, 1.42 lb. Total payload weight, 125.50 lb. This figure, added to the 50 lb. empty fourth-stage rocket motor, and 11.73 lb. weight of the transition section gives a total orbiting mass of 187.23 lb.

Scout launching vehicle: Total weight at lift-off, 36,600 lb.; overall length, 72 ft. First stage: Algol, 30 ft. long by 40 in. dia.; thrust, 103,000 lb.—fin-stabilized and controlled by efflux vanes. Second stage: Castor, 20 ft. long by 30 in. dia.; thrust, exceeding 62,000 lb. Third stage: Antares, 10 ft. long by 30 in. dia.; thrust, exceeding 13,600 lb.—stabilized and controlled by H_2O_2 gas-jets and utilizing lightweight plastic construction throughout. Fourth stage: Altair, 6 ft. long by 18 in. dia.; thrust, 2,800 lb.—spin-stabilized.

Auxiliary parts: Airframe consists of control surfaces surrounding first-stage nozzle, transition sections connecting the four rocket stages, a glass-fibre phenolic protective heat shield covering the third and fourth stages plus payload, the fourth stage spin-up table, and payload attachment structure.

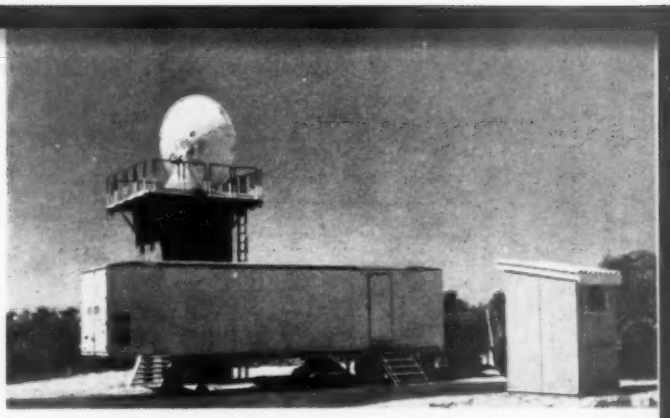
Scout No. 6 leaves the launching stand at Wallops Island bearing in its nose the S-55 micrometeoroid satellite, now termed Explorer XIII.

Australian Contribution

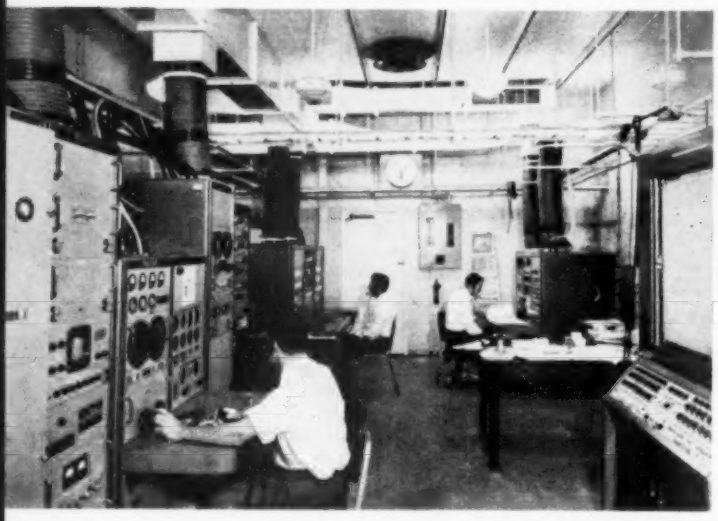
A TRACKING station established at Muchea, 30 miles from Perth in Australia, will play a vital part in the United States Mercury programme, now that sub-orbital testing is giving way to full-orbital missions. It is the only station outside American territory able to "command" re-entry of the capsule. The other command stations are at Cape Canaveral, Florida; Bermuda and Hawaii. Australia has a second tracking station at Red Lake, near the Woomera range-head, but it does not have command facilities.

Muchea is managed and staffed by 30 officers of the Australian Department of Supply's Weapon Research Establishment, augmented by a few Americans on specialist duties. The cost of construction and installation work at Muchea, £A182,000, was met by the United States.

The facilities include equipment for tracking the capsule, communicating with the astronaut by voice, and monitoring the physiological condition of the astronaut and the capsule's contents by telemetry. The Muchea station is also capable of setting or commanding the exact time of firing of the retro rockets which will initiate the capsule's re-entry into the Earth's atmosphere.



This mobile unit (above) is part of the United States equipment established at Muchea for use in conjunction with Project Mercury. It houses VERLORT (Very Long Range Tracking) radar, capable of tracking suitable space "targets" at distances up to 2,400 miles.



Above, telemetry equipment at Muchea. It will receive signals from the orbiting capsule giving information on the astronaut's blood pressure, pulse rate, heart beats and respiration.

Left, control room of the Mercury tracking station at Muchea in Western Australia, which is located some 30 miles north of Perth.

Space-port at Canaveral

AFTER making an extensive survey of possible launching sites for manned spaceflight operations, such as lunar missions requiring advanced Saturn and Nova-class boosters, the National Aeronautics and Space Administration announced on Aug. 24 that they will use "expanded facilities" at Cape Canaveral. This will involve the acquisition of approximately 80,000 acres north and west of the present Air Force Missile Test Center at a cost estimated at $60 million. Present facilities at the Cape including nearby Patrick Air Force Base cover some 17,000 acres. The additional area will be administered by the U.S.A.F., as agent for NASA as part of the Atlantic Missile Range.

The choice of the Florida area for the launching of multi-million-pound thrust boosters follows the result of a very thorough survey carried out by NASA in conjunction with the Department of Defense into a number of possible launching sites, both in the United States and in the Pacific Ocean. Criteria applied in the site selection included "trajectory advantages relating to launch azimuths; hazards of overflight or booster impact in populated areas; speed of expansion in terms of cost, time and land availability; water transportation access; existing instrumentation support; and adjacent air support facilities."

The proposed expansion at Cape Canaveral will permit construction and operation of six or more Saturn and Nova-class launching vehicle complexes. It has been estimated that Nova-class boosters, with as much as 20 million lb. thrust in the first stage, will require protective land radii of up to 10 miles. This exacting requirement apparently can be accommodated.

If the flight testing of large boosters is to meet proposed target dates for lunar missions in the later 'sixties, it is considered necessary to begin preparing the new launch area "in six to 12 months." This would be one of three major steps to accelerate the United States space programme. Others are the establishment of a manned spaceflight research centre, and a booster fabrication and test facility. Sites for both of these are under urgent study.

Space-tracking Award

SIR BERNARD LOVELL, Director of the Nuffield Radio Astronomy Laboratories of the University of Manchester, has been chosen by the International Academy of Astronautics as the first recipient of the Daniel and Florence Guggenheim International Astronautics Award. This award, which carries with it a prize of one thousand dollars, it to be given each year to an individual who has made outstanding contributions to the progress of astronautics during the preceding five years.

The Nuffield Radio Astronomy Laboratories have the World's biggest fully steerable radio-telescope, at Jodrell Bank. When the first Sputnik was launched in 1957, Professor Lovell placed this unique instrument, which is being used primarily for radio astronomy research, at the service of astronautics. Since then, he and his collaborators have tracked various American and Soviet space-vehicles. In September, 1959, the radio-telescope recorded the first impact on the Moon by Russia's Lunik II, and a few months later, followed the American Pioneer V for about 22.5 million miles.

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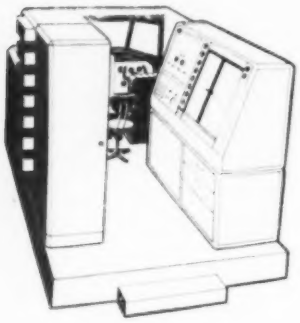

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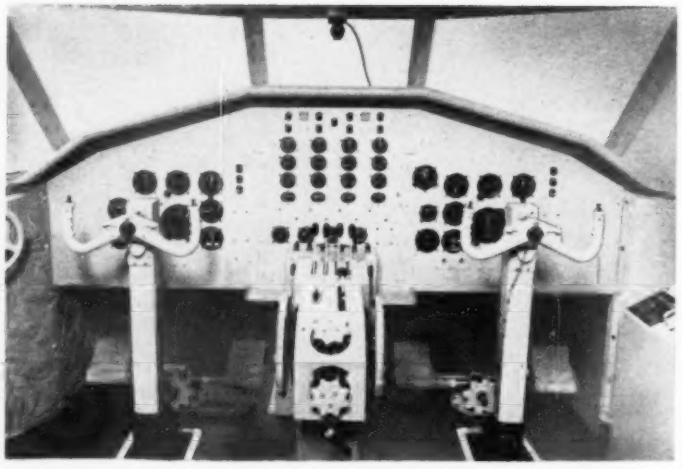

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An Early Flexible

PICTURES of the interesting Ryan experimental "flex wing" aircraft published in THE AEROPLANE AND ASTRONAUTICS for Jly. 27 prompts me to send the enclosed photograph. It shows a glider of similar conception, which was built and flown in the winter of 1922/23 by Reinhold Platz, for many years the chief designer of this company. His "Zeilvliegtuig" has, I think, reasonable claim to the title of the simplest man-carrying aerodyne ever built. Its weight was about 70 lb.

We have a reproduction of a photograph in this office which shows a man transporting the machine to the sand dunes on Walcheren where it was flown. The hazardous-looking method was simply to wind the "sails" around the various booms that comprised the structure, and carry the lot, bundled, across one shoulder while riding a bicycle.

An interesting point about this machine is that its cotton flying surfaces were in the same relation, in the horizontal plane, as the fore and main sails of a yacht are in the vertical plane, when they are close-hauled and the vessel beating to windward. In plan form the aircraft was simply the sailplan of a Bermuda-rigged sailing dinghy duplicated about the longitudinal axis. Control was exercised by the simultaneous or differential flexing of the two "foresails" through a boom in each hand. The "mainsail" was in one piece, being of delta form with a straight leading edge.

Amsterdam. ROBERT R. RODWELL,
Public Relations Dept.
N.V. Koninklijke Nederlandse
Vlietuigenfabriek Fokker.

More about 216 Squadron

THIS Squadron left Marquise, France, in June, 1919, sailed from Marseilles to Port Said aboard the Holland Lloyd "Princess Juliana," took over X Aircraft Park, Kantana, as part of the "Blazing Trail" under Major M. R. Read of 45 Squadron; 214 Squadron (Major Brown) settled at Abu Suer; 58 Squadron at Heliopolis (Major Ivor Lloyd). I remember no D.H.10s, only Vimys flown out from Bircham Newton as replacements.

The most outstanding feature was the large amount of transport taken—the number of Leyland trucks, Crossley trucks and Clayton Dorman tractors shipped out far exceeded those of any individual squadron in either war; they were not needed as Middle East Brigade was cluttered up with them.

Boscombe Down. L. C. NICHOLS.

[Previous letters on this subject were published in our issues for Aug. 3 and Jly. 20 which followed a report in our Jne. 29 issue giving details of the Squadron's "adoption" by the Worshipful Company of Coachmakers and Coach Harness Makers.—ED.]

Gatwick's "Iron Curtain"

HAVING recently received my copy of your journal dated Jly. 13 and turning to the centre pages containing Mr. Peter Masefield's remarkable selection of photographs, may I congratulate both the distinguished photographer and you, Mr. Editor, for so prominently exposing this "bureaucracy gone mad" nowadays on the majority of Britain's airports, controlled and administered by the Ministry of Aviation, and more especially, Gatwick and Heathrow.

Why, the airlines ask, does Britain keep on increasing its airports' landing fees? Why, they ask again, cannot they have more control over airport expenditure? Mr. Masefield's delightful photographic studies show so vividly just *one aspect* of Ministerial extravagance. There are countless others which are too numerous to mention in a letter.

Your excellent cartoonist Chris Wren should easily be able to supplement Peter Masefield's campaign in regard to the above subject! In the issue of your journal of Apr. 6, page 369, he jokingly refers to flying by B.O.A.C. Britannia "by way of the Idlewild shambles." Really Mr. Wren, with so many U.K. airports "shambles" on your doorstep, why bother to go all the way to New York to elaborate on this subject?

Nairobi. DENNIS M. POWELL.

Publications Received

Modern Airmanship, edited by Brig.-Gen. Neil D. Van Sickle. Second, extensively revised edition of a handbook dealing thoroughly with all aspects of flight to provide basic information for civil or military pilots. The chapter headings give an indication of the scope, and include: The Atmosphere, Basic Aerodynamics and the Theory of Flight, Structures, Propulsion, Instruments and Operational equipment, Medical Aspects, Flight Techniques in Light Aircraft, Weather, Instrument Flying, Navigation and much else. 816 pp. 6 in. by 9 in., illustrated. D. Van Norstrand Co., Inc., 73s. 6d.

The Narrow Margin, by Derek Wood and Derek Dempster. A new and painstaking account of the Battle of Britain, seen in its proper context as the climax of the development of air power in Germany and Britain from 1930. Much new information is included on the relative development of radar and fighter control techniques in the two countries, and the events of the battle itself are usefully described in the form of day-to-day summaries from Jly. 10 to Oct. 31, 1940. 536 pp. 5½ in. by 8½ in., illustrated. Hutchinson and Co., 35s.

The Air Force List, April, 1961. Latest unrestricted edition. H.M.S.O., £2.

Fokker—the Man and the Aircraft, by Henri Hegener. This latest "Harborough," in the customary format, comprises three main sections—a detailed and well-illustrated history of Anthony Fokker and his products; a series of three-view tone drawings to a common scale; and a type-by-type review (by E. F. Cheesman) of more than 200 Fokker aircraft and variants. 224 pp., 8½ in. by 11 in.; illustrated. Harleyford Publications, Ltd. 45s.

Glory Gamblers, by Lesley Forden. An original "paperback" telling the story of the 1927 Dole Air Race from San Francisco to Hawaii, where only two of the nine competitors arrived. 160 pp., 4 in. by 7 in. Ballantine Books, New York. 35 cents.

Kennzeichen der Verkerhrsflugzeuge.—A handbook listing, by country and airline, the registrations of the World's airliners. 96 pp., 4¼ in. by 6¼ in.; illustrated. World Traffic Edition, Pestchechkonto Hb 1647, Dr. T. Weder-Greiner, Chardonne, Vevey, Switzerland. Fr. 2.50.

The Mechanics of Inertial Position and Heading Indications, by Winston-Markey and John Hovorka. A study for graduate students and "engineers of modest professional experience" of an inertial navigation system based on classical mechanics. 94 pp., 5½ in. by 8½ in.; illustrated. Methuen and Co., Ltd. 21s.

The Boys' Book of World Airlines, by Kenneth Wolstenholme. In twelve chapters the author describes all that is involved in modern air travel, and includes brief directories of the World's airlines and airliners. 144 pp., 7¼ in. by 9¾ in.; illustrated. Burke Books. 10s. 6d.

The Observer's World Aircraft Directory, by William Green. A massive compilation, at a bargain price, including directories of the World's air forces and airlines, with their equipment; glossaries of aeronautical terms; guides to current aero-engines and air-launched missiles; international records; and the World's aircraft. The last-mentioned section includes a photograph and descriptive text for each of nearly 550 aircraft types. 354 pp., 7½ in. by 5¼ in. Frederick Warne and Co., Ltd. 15s.

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Industry Record

Towards Filter Efficiency

At the Leamington Works of the PurOlator Filter division of Automotive Products a fully equipped test house has recently been brought into operation for the complete and thorough testing, to approved standards, of any filter/water separator or bulk capacity filter. Filter-separators have not only to contend with solid contaminants, they also may need to deal with water which may be emulsified or in the form of slugs such as found in bulk fuel tanks after long periods of standing. The whole test sequence for which the plant has been designed is, therefore, intended to simulate such conditions but in a more drastic form.

Two kerosene storage tanks, each of some 9,000-gal. capacity, provide the fuel for test purposes. These are outside the test house proper and have filling points arranged so that they can be supplied direct from mobile tankers. Fuel is drawn off through an 8-in. main, to which either or both tanks can be coupled, and pumped through to the test area. These each deliver up to 600 g.p.m. at 135 p.s.i. or can be coupled to give a total delivery, still at 135 p.s.i., of 1,200 g.p.m.

For simulating solid water contamination conditions a water slugging vessel is interposed in the main test line. From this the slug, or charge, of water is passed through the main line to the filter under test through which it will pass as a solid stream. For normal test conditions water is introduced into the feed lines at the pre-pump stage so that as it passes through the Pegson pumps it will be emulsified to a high degree before passing to the test unit.

For large-capacity filters the pressurized liquid is taken through 6-in. mains; for the smaller type through a low-flow 4-in. main. Water for test purposes is taken by way of a bank of Rotameters with 0.05 to 50 g.p.m. capacities and these, too, can be coupled.

As the fluid passes through the mains it can be visually checked by the operator through sight glasses positioned both before and aft of the test stage. For testing the efficiency of the filter, sampling points are interposed at various stages of the test from which actual samples of the contaminant, before and after filtration, can be drawn off isokinetically and examined in a test laboratory above the test unit.

For the testing of bulk filters two tanks of some 50 to 60 gal. each are employed from which liquefied contaminant is drawn off through two pumps, each one capable of passing 20 g.p.m. at 75 p.s.i. and can be operated in series or in parallel. When operated in parallel the combined pressure of 150 p.s.i., being above that of the main flow line, ensures that the contaminant will be forced straight to the test filter without fear of blockage through back-pressure build-up.

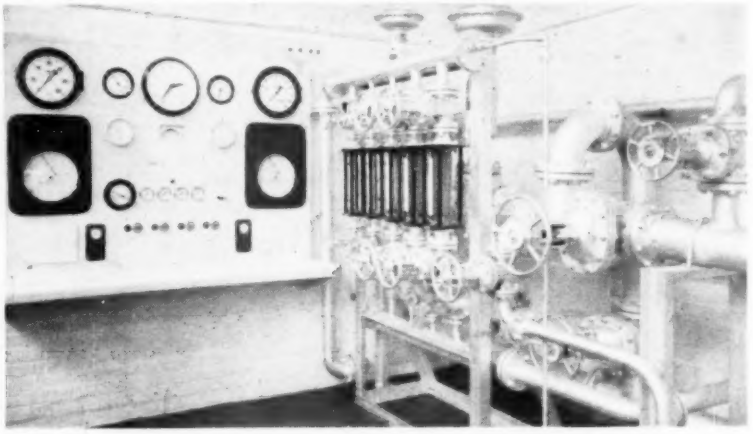
Virtually any type of solid contaminant can be introduced for testing the filters to simulate local conditions, but where this is not specified the principal medium used is black magnetic iron oxide. Aluminium oxide and red oxide are also used occasionally and, to a much lesser degree, a zinc based contaminant is sometimes employed.

Whatever form of contaminant is selected, it is first mixed with kerosene to form a "slurry," so representing the normal state in which it would pass through a filter in service. A hopper feed mechanism is used for injecting the powder into the mixing tank at the base of which tangentially placed jets spray kerosene at high pressure on to the dust to form a controlled slurry. In this state it is pumped to the test filter.

After the contaminated fluid has been passed through the test unit it can be fed into a bulk fuel filter, a filter-separator or through the two; or, if completely free from contamination, it can be by-passed from the filter area completely.

The complete test sequence is controlled by an operator at a fully equipped test panel adjacent to the unit under test. From this panel he is able to start up the main pump units, control the rate of flow, accurately meter the amount of contaminant to be fed into the test filter, check the temperature of the fluid, and switch off or by-pass any part of the test sequence at will.

A further feature of the test equipment is that everything is repeated in miniature so that test of individual elements or small filters can be carried out in exactly the same way.



The main control panel and the Rotameter bank (for measuring the water flow through the units on test), of the new Automotive Products PurOlator test house.

Aviation Calendar

Sept. 8

Fairwood Common.—Popular Flying Association Rally; until Sept. 10—(not at Cranfield as stated in our issue of Aug. 24).

Sept. 12

London.—R.Ae.S. 49th Wilbur Wright Memorial Lecture, "Researches in Space Flight Technology," at 4 Hamilton Place, W.1, at 19.00 hrs.

London.—R.A.F. Battle of Britain Exhibition at Richmond Terrace and Air Ministry Building, Whitehall, S.W.1; until Sept. 17.

Sept. 13

Baden-Baden.—German Aero Club Second International Sporting Pilots' Rally.

Sept. 16

R.A.F. At Home.—Battle of Britain Day; 16 R.A.F. stations open to the public.

Sept. 17

London.—Battle of Britain Service of Thanksgiving at Westminster Abbey.

Sept. 22

Oxford.—Institute of Transport Week-end Conference; until Sept. 25.

Sept. 23/24

Munich.—Munich Flying Group Second Oktoberfest Rally.

Company Notices

NEW COMPANIES

Heliconair, Ltd. (701,198).—Private co. Reg. Aug. 18. Cap. £100 in £1 shs. To carry on the business of charterers of aeroplanes, helicopters. Sec.: Dorothy F. Craig. Reg. off.: 33 Harris Street, Darlington, Co. Durham.

Waddington Flying Club, Ltd. (700,730).—Reg. Aug. 14, as a company limited by guarantee without share capital. Original number of members is 25, each being liable for £5 in the event of winding up. The income and property of the Association whencesoever derived shall be applied solely towards the promotion of its objects. Sec.: D. C. Tackley. Reg. off.: Station Headquarters, Royal Air Force, Waddington, Lincs.

Increases in Capital

Marshalls Flying School, Ltd. (245,740), 18 Jesus Lane, Cambridge.—Increased on Dec. 23, 1960, by £75,000 in £1 ordinary shrs., beyond the registered capital of £75,000.

Oxford Aviation Co., Ltd. (624,137), Oxford Airport, Kidlington, Oxford.—Increased on Dec. 19, 1960, by £72,000, beyond the registered capital of £3,000.

CHANGES OF NAME

Airspeed, Ltd. (549,321), Hatfield Aerodrome, Hatfield, Herts.—Name changed to De Havilland Export, Ltd., on Mar. 15, 1961.

Airwork (Helicopters), Ltd. (552,382), 35 Piccadilly, W.1.—Name changed to Airwork International, Ltd., on Mar. 6, 1961.

Argus Air Transport, Ltd. (576,593), 26 Dorset Street, W.1.—Name changed to Autair (Luton), Ltd., on Mar. 24, 1961.

De Havilland School of Flying, Ltd. (505,984), Hatfield Aerodrome, Hatfield, Herts.—Name changed to Airspeed, Ltd., on Mar. 21, 1961.

Product Design Associates, Ltd. (597,231), Aircraft interior designers, etc., 72 Wigmore Street, W.1.—Name changed to Form and Design Associates, Ltd., on Mar. 2, 1961.

New Patents

APPLICATIONS ACCEPTED

878,949.—**ACF Industries Inc.**—"Flight training apparatus." Oct. 8, 1959.

878,721.—**Power Jets (Research and Development), Ltd.**—"Helicopters." Jan. 12, 1960. (Oct. 31, 1958.)

878,914.—**W. Czerwinski.**—"Combination of an aircraft and an installation to assist the take-off and landing of the aircraft." Jan. 28, 1959. (Feb. 5, 1958.)

878,626.—**Rolls-Royce, Ltd.**—"Jet deflector for a jet propulsion engine." Dec. 29, 1959. (Dec. 30, 1958.)

Printed specifications of the above will be available on Oct. 4, 1961, and the opposition period will expire on Jan. 4, 1962.

Personal Notices

BIRTHS

Archer.—On Aug. 14, to Valda (*née* Smart), wife of Wg. Cdr. H. D. Archer—a daughter.

Atkinson.—On Aug. 19, at R.A.F. Nocton Hall, to Pat (*née* Turner), wife of Flt. Lt. J. Atkinson—a daughter.

Beetham.—On Aug. 14, to Patricia, wife of Wg. Cdr. M. Beetham—a son.

Bramwells.—On Aug. 11, at R.A.F. Nocton Hall, to Barbara (*née* Instrell), wife of Flt. Lt. H. Bramwells—a son.

Goode.—On Aug. 3, at R.A.F. Hospital Akrotiri, Cyprus, to Jeanne (*née* Askelund), wife of Wg. Cdr. G. E. F. Goode—a son.

McLean.—On Aug. 22, at P.M.R.A.F. Hospital, Halton, to Rosina, wife of Flg. Off. D. McLean—a son.

Mullarkey.—On Aug. 15, at Grimsby Maternity Hospital, to Carol, wife of Sqn. Ldr. D. Mullarkey—a daughter.

Osborne.—On Aug. 10, at Holyhead, to Anne, wife of Flt. Lt. P. R. P. Osborne—a daughter.

Watson.—On Aug. 11, at Aldershot, to Rosalie (*née* Millar), wife of Sqn. Ldr. C. W. Watson—a son.

DEATHS

Colville.—On Aug. 20, Wg. Cdr. Arthur Colville, O.B.E.

Cox.—On Aug. 19, at Lodge House, Rudgwick, Sussex, Air Cdre. Claude Russell Cox, C.B.E., A.F.C., D.L., R.A.F. (retd.).

Hill.—On Aug. 18, at P.M.R.A.F. Hospital, Halton, Wg. Cdr. Rowland Hill, O.B.E., A.F.R.Ae.S.

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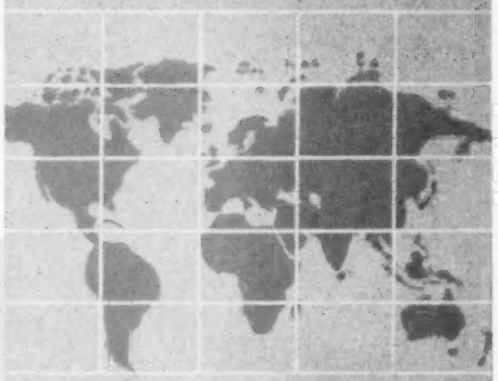

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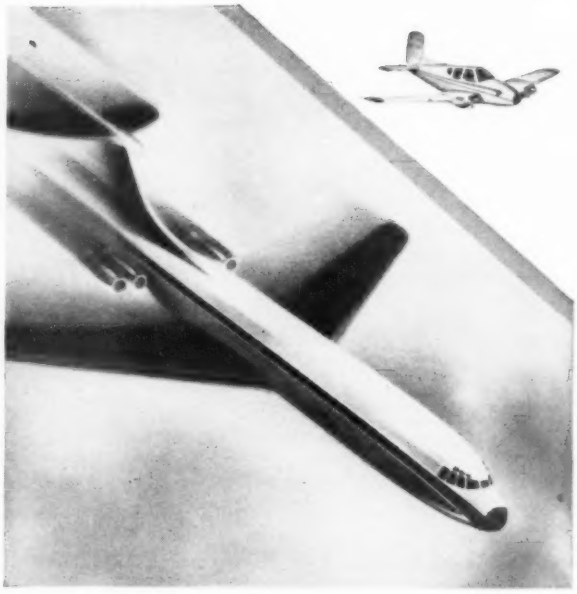

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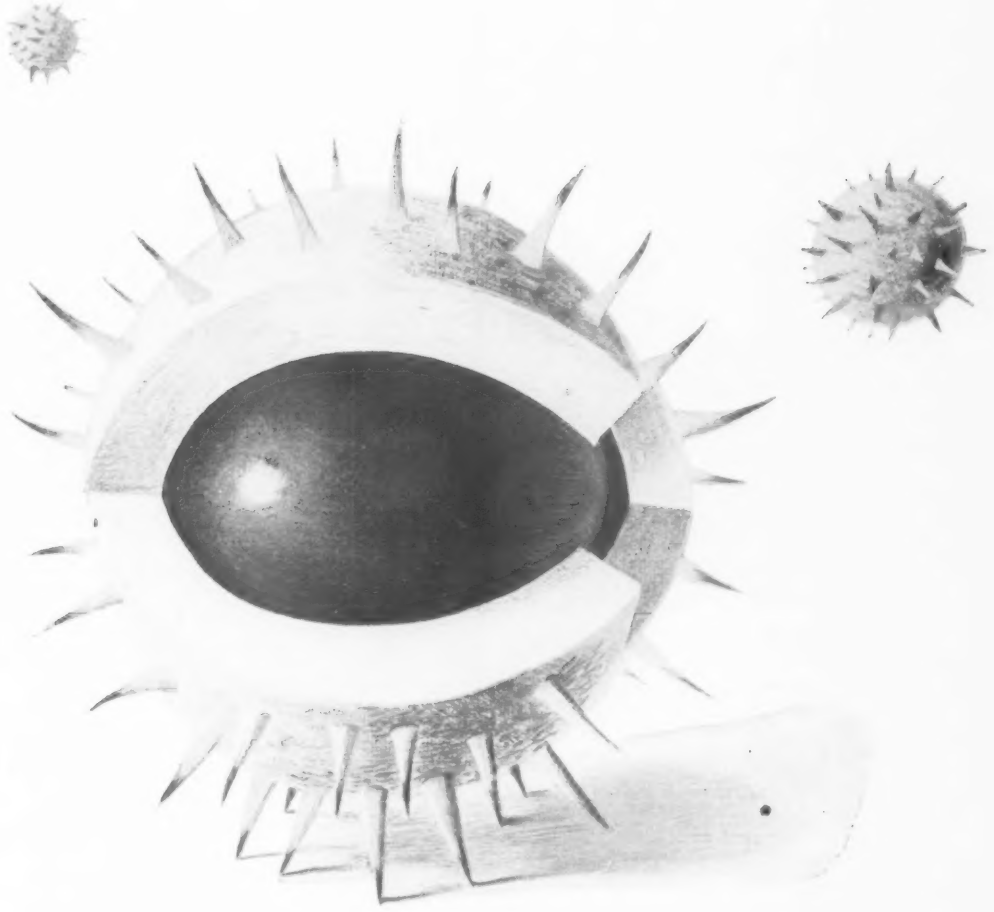

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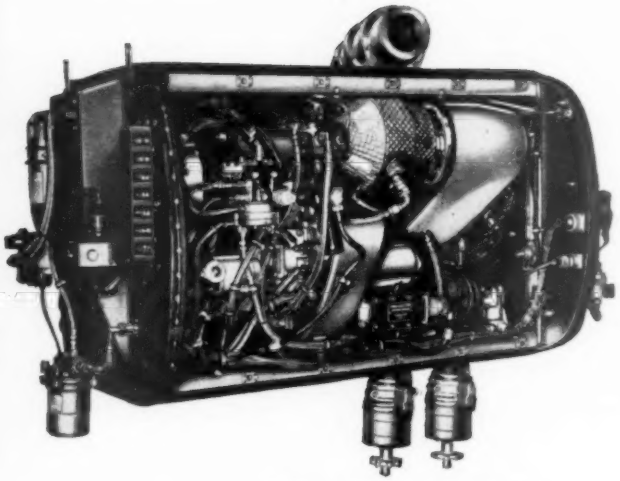

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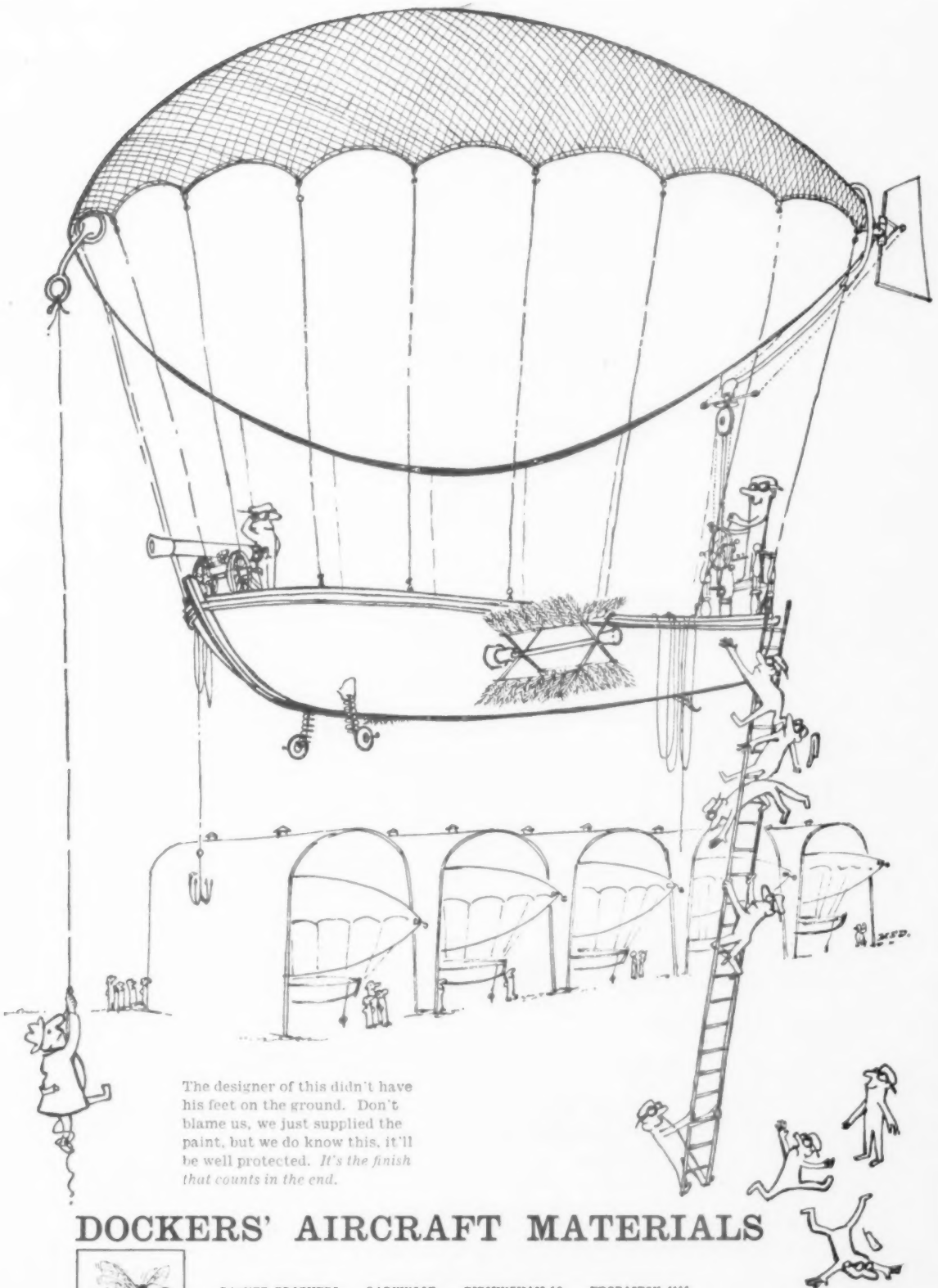

The designer of this didn't have his feet on the ground. Don't blame us, we just supplied the paint, but we do know this, it'll be well protected. *It's the finish that counts in the end.*

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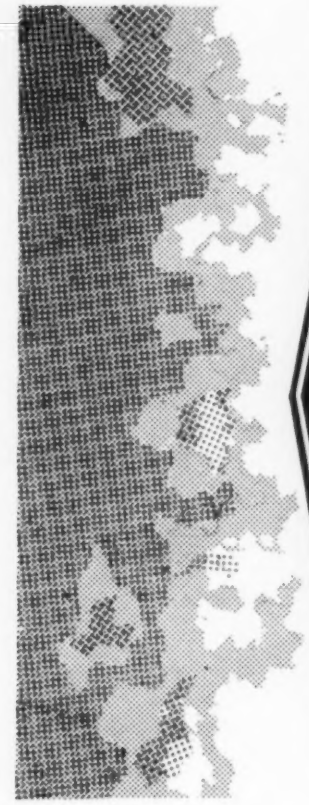

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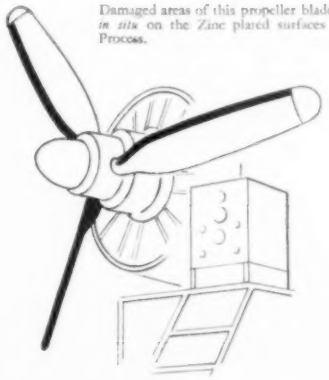
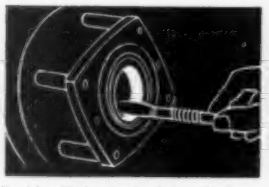


Damaged areas of this propeller blade repaired *in situ* on the Zinc plated surfaces by Dalic Process.



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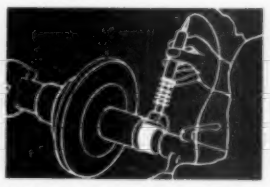

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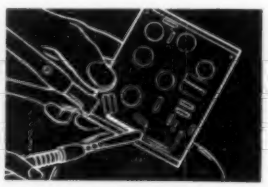

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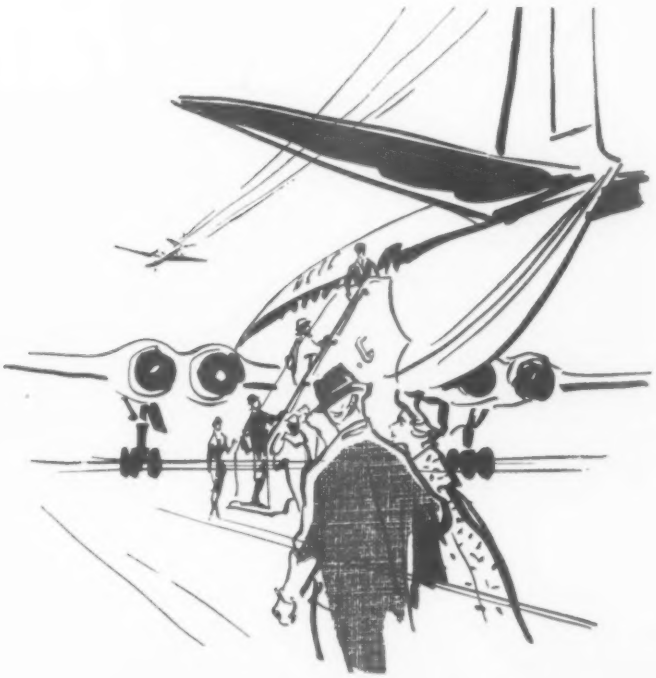

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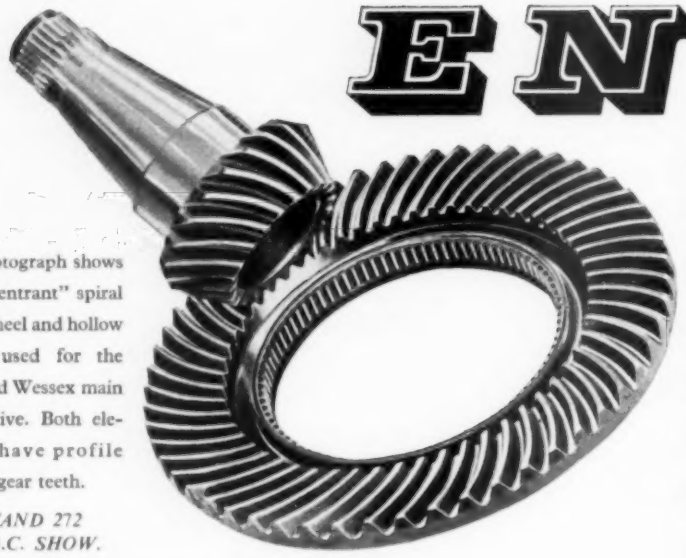

The photograph shows the "re-entrant" spiral bevel wheel and hollow pinion used for the Westland Wessex main rotor drive. Both elements have profile ground gear teeth.

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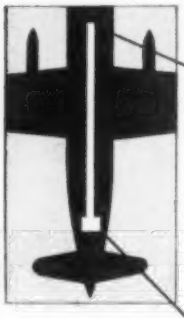

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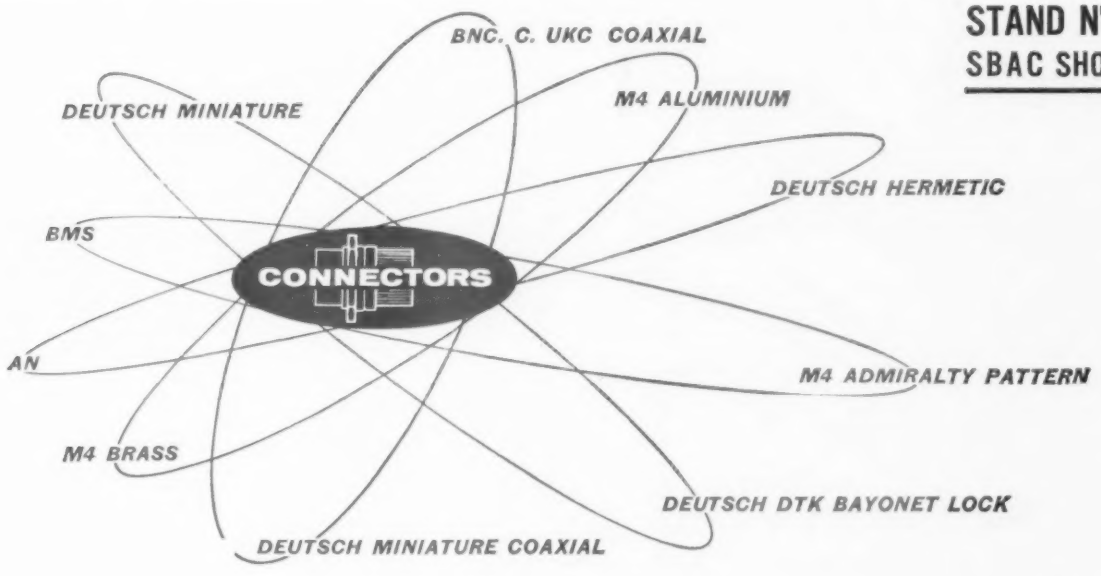

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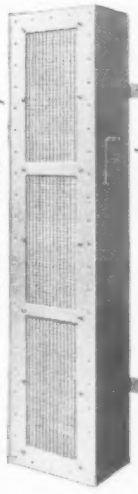

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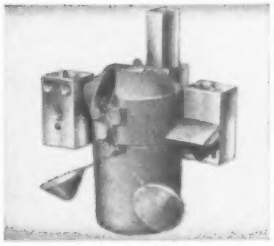

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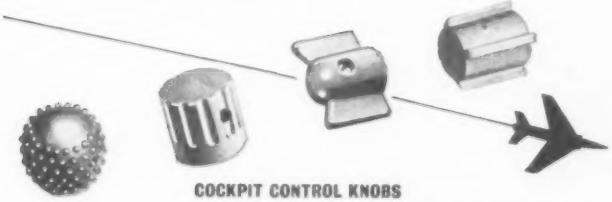

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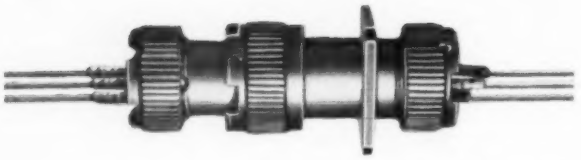

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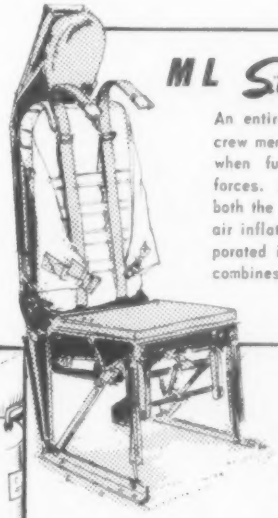

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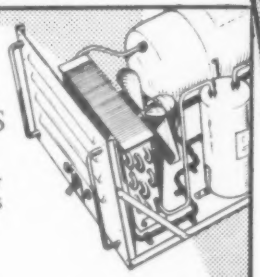

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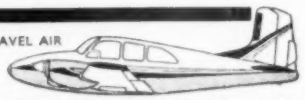

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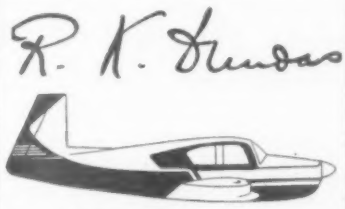

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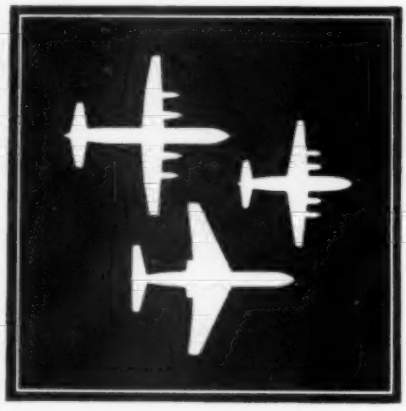

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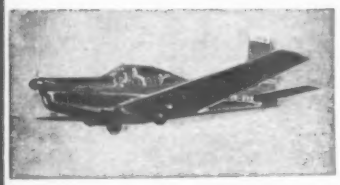

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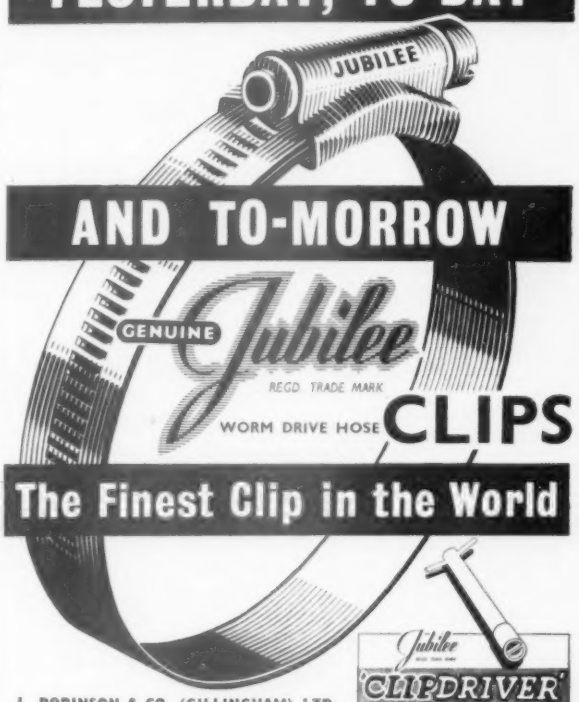

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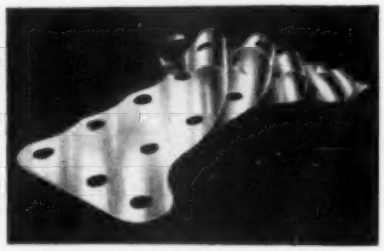

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Adcola Products, Ltd.	82
Aero Controls, Ltd.	74
Airwork Services, Ltd.	64, 80, 82
Associated Electrical Industries, Ltd.	49
Attewell, B., & Sons, Ltd.	84
Avery-Hardoll, Ltd.	5
Aviation Traders (Engineering), Ltd.	82
B	
Beaufort (Air-Sea) Equipment, Ltd.	18
Bell's Asbestos & Engineering, Ltd.	68
Blackburn Engines, Ltd.	Front Cover
Boeing Company, The	15
Boulton Paul Aircraft, Ltd.	8
Bradley G. & E., Ltd.	73
Bristol Siddeley Engines, Ltd.	43
British Airline Pilots Association	83
British European Airways	80
British Executive & General Aviation, Ltd.	41
Britool	74
Burnley Aircraft Products, Ltd.	14
C	
Clifford, Peter S., & Co., Ltd.	81
Cossor Radar & Electronics, Ltd.	51
Cross Manufacturing Co. (1938), Ltd.	82, 83
C.W.C. Equipment, Ltd.	76
D	
Darchem Engineering, Ltd.	45
Docker Brothers, Ltd.	67
Dundas, R. K., Ltd.	79
E	
Ekco Electronics, Ltd.	64
Elliott Bros. (London), Ltd.	38, 39
English Electric Co., Ltd. Aircraft Equipment	57
E.N.V. Engineering Co., Ltd.	72
F	
Fairey Engineering, Ltd.	49
Ferranti, Ltd.	24, 69
Fiat—Divisione Aviazione—C	42
Fibreglass, Ltd.	19
Flexible Ducting, Ltd.	Back Cover
Flight Refuelling, Ltd.	60
G	
General Precision Systems, Ltd.	62
Godfrey, Sir George, & Partners, Ltd.	Inside Front Cover
Goodmans Industries, Ltd.	16
Goodyear Tyre & Rubber Co. (Gt. Britain), Ltd., The	52
Graseby Instruments, Ltd.	12
Graviner Manufacturing Co., Ltd.	50
H	
Hall & Hall, Ltd.	77
Handley Page, Ltd.	33
Hawker Siddeley Aviation, Ltd.	28
Hellermann, Ltd.	76
High Duty Alloys, Ltd.	22
Hobson, H. M., Ltd.	11, 81
Hollandse Signaalapparaten, N.V.	71
Hong Kong Aircraft Engineering Co., Ltd.	70
Hymatic Engineering Co., Ltd., The	20
I	
International Aeradio, Ltd.	80
K	
Keegan Aviation, Ltd.	79
Killick Martin & Co., Ltd.	70
L	
Lucas Gas Turbine Equipment, Ltd.	54, 55
M	
Mallinson, William, & Sons, Ltd.	72
Marconi's Wireless Telegraph Co., Ltd.	59, 61, 63
Martin-Baker Aircraft Co., Ltd.	1
Marvin Tomkins, Ltd.	83
Metachemical Processes, Ltd.	70
Microcell, Ltd.	37
Ministry of Aviation	82
M.L. Aviation Co., Ltd.	77
Murex Welding Processes, Ltd.	44
N	
Nord-Aviation	9
P	
Page Engineering Co. (Sunbury-on-Thames), Ltd.	25
Park, R. & J., Ltd.	76
Pitman, Sir Isaac, & Co., Ltd.	83
Plessey Co., Ltd., The	29, 30, 31, 32
Premier Precision, Ltd.	Inside Back Cover
Pritchett & Gold, and E.P.S. Co., Ltd.	58
Pye-Ling, Ltd.	36
Pyrene Co., Ltd., The	7
R	
Rapp Leo, Ltd.	75
Redifon, Ltd.	4
Reid & Sigrist, Ltd.	23
Rellumit (London), Ltd.	10
Rists Wire & Cables, Ltd.	56
Robinson, L., & Co. (Gillingham), Ltd.	83
Rollason Aircraft & Engines, Ltd.	78, 81
Rolls-Royce, Ltd.	34, 35
Rotax, Ltd.	54, 55
Rover Co., Ltd., The	66
S	
Sangamo Weston, Ltd.	66
Sciaky Electric Welding Machines, Ltd., The	27
Scottish Aviation, Ltd.	40
Shackleton Aviation, Ltd.	78
Shell Aviation Services	53
Short Bros. & Harland, Ltd.	78
Simmonds Aerocessories, Ltd.	13
Smart & Brown (Machine Tools), Ltd.	73
Smiths Aviation Division	2, 3
Southend Municipal Flying School	83
Standard Telephones & Cables, Ltd.	6
Staravia, Ltd.	82
Super Oil Seals & Gaskets, Ltd.	21
T	
Technical Platings, Ltd.	68
Thermal Control Co., Ltd.	74
Thorn Electrical Industries, Ltd.	26
V	
Vandervell Products, Ltd.	46, 47
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W	
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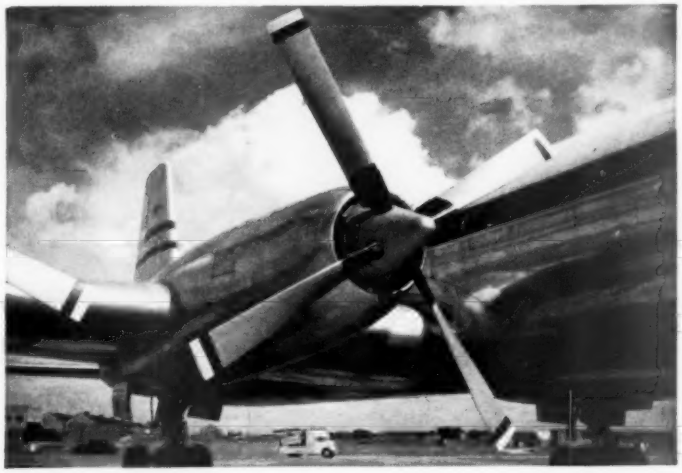

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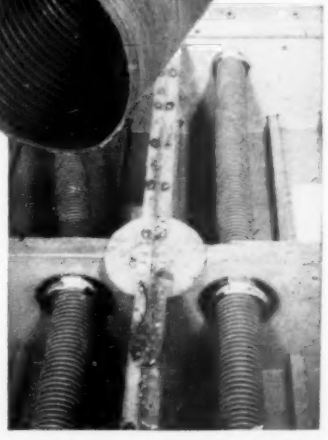

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